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THE EIGHTEENTH OR 1948 ANNUAL INSECT POPULATION SUMMARY OF KANSAS[1]

ROGER C. SMITH[2] AND GEORGE A. DEAN[2]
Kansas Agricultural Experiment Station

This insect population summary for Kansas covers the calendar year 1948 and is the 18th and last of this series which began with the year 1931.[3] The information recorded here is based on a summary of 335 questionnaires of the score card type from the sources indicated in Table I, together with the observations and reports of the authors and their colleagues, and of those returning the score sheets.[4]

TABLE I

Source and Numbers of Questionnaires Summarized For This Report

	Number returned in July	Number returned in Oct.
Group 1. Entomologists in the state	9	9
Group 2. County agricultural agents	68	74
Group 3. Farmers, mostly college graduates	29	33
Group 4. Vocational agricultural teachers	51	50
Group 5. Agronomists and horticulturists	8	8
Total reports of each group	161	174
Grand total of all questionnaires summarized for this report	335	
Number of counties reporting	103	

Summary of Weather Conditions in Kansas by Months During 1948[5]

TABLE II

The summary of the year's weather by months which has been included in former insect population reports is omitted because of the excellent published report by Flora (1949) "Kansas Weather: 1948."[6] A few of the more significant statements from that report are included in the summary of this paper.

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[1] Contribution No. 570 from the Department of Entomology, Kansas State College.
[2] Entomologists of the Kansas Agricultural Experiment Station.
[3] For the other summaries in this series, see the **Journal of the Kansas Entomological Society** for the summaries for 1931 (vol. 5); 1932 (vol. 6); 1933 (vol. 7); 1936 (vol. 10); 1937 (vol. 11); 1939 (vol. 13); 1942 (vol. 16); 1943 (vol. 17); 1944 (vol. 18); 1945 (vol. 19); 1946 (vol. 20); and for 1947 (vol. 21). The **Transactions of the Kansas Academy of Science** for 1934 (vol. 38); 1935 (vol. 39); 1938 (vol. 42); 1940 (vol. 44); and for 1941 (vol. 45).
[4] Recognition and appreciation for assistance given during the preparation of this summary are due to the same sources and largely to the same individuals who supplied information for recent, previous reports. The questionnaires were sent to the county agents by E. G. Kelly, extension entomologist who died February 7, 1949.
[5] Notes and Table II based on Climatological Data: Kansas Section Weather Bureau, U.S. Dept. of Commerce by S. D. Flora, Vol. 62, 1948.
[6] Flora, S. D. Kansas Weather: 1948, Kans. Acad. Science, Trans. 52 (1):1-12, March, 1949.

Table II

Summary of Weather Data for the State of Kansas for the period September 1, 1947 to December 31, 1948.

	Temperature in degrees Fahrenheit						Precipitation in inches				
Month	State Mean	Maximum	Minimum	Mean for 61 years	Departure from normal	State Average	Average for 61 years	Departure from normal	Eastern third	Middle third	Western third
1947											
Sept.	74	117	30	69.8	+4.2	1.40	2.83	-1.43	3.27	0.47	0.46
Oct.	65.8	104	25	57.5	+8.3	1.29	1.98	-0.69	2.11	1.06	0.69
Nov.	39.5	72	-8	43.2	-3.7	1.15	1.27	-0.12	1.38	1.06	1.01
Dec.	34.5	73	-6	33.1	+1.4	2.07	0.89	+1.18	2.71	2.33	1.16
1948											
Jan.	27.9	76	-23	30.1	-2.2	0.59	0.70	-0.11	0.85	0.56	0.35
Feb.	30.9	79	-15	33.3	-2.4	1.62	0.99	+0.63	1.28	2.37	1.22
March	36.9	82	-25	43.4	-6.5	2.73	1.50	+1.23	3.93	2.26	2.00
April	61.1	100	17	54.9	+6.2	1.28	2.69	-1.41	2.40	1.17	0.27
May	64.7	104	26	63.8	+0.9	2.69	3.80	+0.90	3.33	2.24	2.50
June	73.6	108	45	73.8	-0.2	6.57	4.08	+2.49	7.48	7.32	4.92
July	77.8	106	45	79.1	-1.3	6.09	3.15	+2.94	8.57	6.55	3.15
Aug.	77.3	105	48	78.0	-0.8	3.01	3.15	-0.14	2.66	2.81	3.68
Sept.	72.0	107	29	69.8	+2.2	1.42	2.81	-1.41	2.17	1.45	0.77
Oct.	56.9	94	17	57.5	-0.6	0.96	1.96	-1.02	1.69	0.94	0.37
Nov.	42.1	82	6	43.2	+1.1	2.12	1.28	+0.84	2.26	2.58	1.49
Dec.	34.4	86	-26	33.2	+1.2	0.42	0.90	-0.48	0.68	0.39	0.23
Averages or total for '48	54.6	108	-26	55.0	-0.4	24.58	2.25	+4.46	37.30	30.64	20.95

Crop Production Summary For 1948[1]

The total acreage of all crops harvested in 1948 was 21,821,000, compared with 23,588,000 acres in 1947. The wheat crop made a remarkable recovery following very unfavorable conditions prevailing at seeding time in the fall of 1947. Wheat production totaled 231,368,000 bu. It was the third largest Kansas crop, exceeded only by the 1947 crop of 286,702,000 bu. and the 1931 crop of 251,885,000 bu.

Corn and Other Grains: Corn production for 1948 was placed at 81,304,000 bu. which was more than double the 40,443,000 bu. produced in 1947, and the largest crop since 1944. The corn crop made a very good start this year, and an exceptionally fine soil moisture condition with excellent growing weather during July and August accounted for a near-record corn yield. Production of sorghums for grain was estimated at 26,576,000 bu., the second largest crop on record. Sorghum forage production of 1,584,000 tons compares with 1,385,000 tons last year. Oats production was 26,312,000 bu. compared with 40,455,000 bu. last year. Barley production of 6,678,000 bu. was 8 per cent higher than 1947, but only 57 per cent of the 10-year average.

Soybeans and Flax: Kansas' 1948 soybean production was estimated at 2,505,000 bu. compared with 1,887,000 bu. last year and the record of 2,534,000 bu. produced in 1944. Flaxseed production was placed at 396,000 bu., which

[1] From Kansas 1948 Crop Review, Kansas State Board of Agriculture, Statistics Division, December 20, 1948. (Mimeographed Release).

compares with 749,000 in 1947 and the 10-year average of 957,000 bu. Flaxseed acreage declined about 33 percent from 1947.

Hay and Seed Crops: Kansas all hay production of 3,565,000 tons compares with 3,116,000 tons in 1947 and 2,327,000 tons in 1946. Most of the increase was in alfalfa of which 2,411,000 tons were produced in 1948 and 1,981,000 tons in 1947. Favorable conditions throughout the growing season were largely responsible for the record alfalfa yield of 2.35 tons per acre. These conditions, however, greatly reduced the acreage of alfalfa cut for seed. Prairie or wild hay production increased slightly, from 772,000 tons in 1947 to 790,000 this year.

Other Crops: Potato production was 1,476,000 bu. or 288,000 bu. more than for 1947, but only two-thirds of the 10-year (1937-46) average. Fruit production this year and last was as follows: apples 376,000 and 755,000 bu.; peaches 160,000 and 12,000 bu.; pears 135,000 and 99,000 bu.; grapes 2,400 and 1,900 tons.

Honey Crop: The honey crop for 1948 was 3,072,000 pounds, or an average yield of 56 pounds per colony compared to 3,360,000 pounds or an average of 40 pounds in 1947. The amount of beeswax for 1948 was 61,000 pounds compared with 54,000 pounds in 1947.

DESCRIPTIVE ACCOUNT OF THE MORE IMPORTANT INSECT ACTIVITIES AND CLIMATIC RELATIONSHIP DURING 1948

Ants were approximately as numerous and annoying during 1948 as in 1947. The questionnaire summary indicates normal numbers. The yellow ant began emerging about the middle of March, and correspondence about them during the spring was approximately normal in amount. The fall swarming species of ants may have been slightly more numerous than last year, judging by correspondence and conditions at Manhattan. As usual, many mistook the winged ants for termites.

Aphids were more numerous than in 1948 and illustrated several unusual features. The outstanding species of the year were green bugs, pea aphids, elm leaf aphids, rhubarb, bean, and tomato aphids, and other species of shade tree and garden aphids. For the state as a whole there were only a few scorings of 4 but many counties were scored at 3.

Aphis fabae Scopuli (identified by Miss Russell of the Bureau of Entomology and Plant Quarantine) occurred on **rhubarb** in destructive numbers

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Table III

Population summary of the more common and important insects in Kansas for 1948, as indicated by questionnaire score sheets from nearly all counties.

KEY

1. Scarce.
2. Plentiful, but damage was neither noticed nor reported.
3. The species was abundant. Some damage was either seen or reported.
4. Local outbreaks. The species was doing severe damage in certain fields.
5. The species was in general outbreak. The insects were doing their greatest damage or were as plentiful as they ever get in a locality.

Note: This table represents the population scorings by counties for each species of insect listed in the questionnaires, insofar as reported. To use it to best advantage, copy the county scores for each species on a state map.

	ANTS, HOUSE	APHIDS, PEA	APHIDS, WHEAT	ARMY WORMS	BAGWORM	BEETLE, LEAF	BLISTER BEETLES	BORERS, TREE	BOT FLY	CABBAGE WORMS	CANKER WORMS	CATTLE GRUB	CHIGGERS	CHINCH BUG	CODLING MOTH	CORN BORER, S.W.	CORN EARWORM	CRICKETS, HOUSE	CUCUMBER BEETLE	CUTWORMS	FALL WEBWORM, NEST	FALL WEBWORMS	FALSE WIREWORMS	FLEAS	FLIES, CATTLE	GARDEN WEBWORM	GRASSHOPPERS	HESSIAN FLY	HOUSE FLY	LEAF HOPPERS	MOSQUITOES	RED SPIDERS	ROSE SLUG	SCALE INSECTS	SCALE, SAN JOSE	SQUASH BUG	STORED GRAIN INSECTS	TENT CATERPILLAR	TERMITES	TOMATO WORM	WEEVILS	WHEAT STRAW WORM	WHITE GRUBS	WIRE WORMS
ANDERSON	1	1			4	3	3	2	1	2	2	3	2	2	2	3		3	2	4	2			2		2	2		4	1	1	2	2	2		2	4	2	3	2	2	1	3	1	2	2	2
ATCHISON	2	2			3	2	2	2		3	1	5	2	1	3	3	5		3	2	3	5		1		2	5		4	3	1	3	3	3	2	2	2	3	1	1	1	1	2	2	2	
BARBER					2	2	2	2	2	4	2	1	3	3				1	2	1	2	3	2		2			3	1	4		2	2	2			1	2	3		1	2	2		2	
BARTON	2		2		2	1	2	2	2	3	4	2	3	1	2	3	4	3	3	3		1	2	4	2	3	2	4	3	2	3	3	3		2	2	2	3		2	2	2	4	3	
BROWN	2	2		2	3	2	3	2	2	2	3	2	3	3	3			3	2	2	3			3		3	2		4	2	2	3	3	3	3	2	2	2	3		2	1	2	2	2	3
BUTLER	1	2	2		2	2	3	1	2	4	5	2	4	3		2	3	2	4	2				3			3		4	2	2	2	2	2			3	2	3			2	4	2	2	
CHASE					3		2	2	2	2	3	5	2	3	3	2		3	2	3	2			2		2	3	5	4		2	2	2	2			2	2	3		2	3	1			
CHAUTAUQUA	1	2			1	2	2	3	1	2	2	4	2	3	3	3		3	2	2	3	3		1		2	2	4	4	1	2	2	2	2			3	2	3	1	2	3	4	1	2	2
CHEYENNE	1	2	2	2	1	3	2	2	2	4	1		3					2	1	1	1			1	1	3	2	2	2		3	2	2	2			2	2	3	1		2	2	3	
CLARK				1	2		2	2			4	3	4						2	3				2		2		4	3	2						1	1	1					2	2
CLAY	2	2	2		2	3	2	2	2	4	4	2	3	2	3			3	2	4	2	1		2	3	2	4		4	2	1	3	3	4	2	2	1	2	2	4	2	3	2	2	
CLOUD	2	2	2	2	2	3	2	2	2	4	4	3	3	3	2	1		1	3	2	3	2		2	3	2	3	1	4	2	3	2	3	3	3	2	4	2	4		2	4	2	2	2	
COFFEY	2	1			3	2	3		2	3	4	2	2	4	2			3	2	2	3	3		3	3	4	1		2	3	2		2	3	2	3		2	2	3		2	2		
COMANCHE												2	3												3	1		2								2								
COWLEY	2	2	2	2	3	3	2	2	2	3	5	2	3	4	3	1		3	2	3	3	4	1	2		2	3	3	4	3	2	2	3	3	1	2	4	2	4	2	3	3	4	2	2	2
CRAWFORD	2	3			3	3	3	3	2	2	3	3	3	4	3			3	2	4	3			2			3		4	2	2	3	3			2	2	2	3	2	2	3	2	2	2	
DECATUR	2	2			2	2	2	2	4		2	1	3	3				2	2	2	2				3	3	3		4	3	2	3	2			2	2	3		2	2		3	3	
DICKINSON	1	2	2	2	2	2	2	2		2	4	2	3	3	3	3	3	3	3	3	3			2	2	1	3	3	4	3	2	3	3	4	2	2	2	3		2	2	3	3	2	
DONIPHAN	3	3			2	3	3	3	3	1		3	3	1	3	3	5		3	1	3	4		1	2		2	3		4	2	2	2	3	3	3	4	2	3	3		3	2	3	2	2	
DOUGLAS	2	3			4	2	2	2	3	3	5	3	3	3	3			3	2	3	2			3		2	3		4	1	2	3	3	3		2	3	3	2	2	4	4	2		
EDWARDS		3	1	2	2	2	2	2	2	3	3	3	4	1		4		2	3	2	2	1	1	3	1	3	2	4	2	2	2	3	2	1	2	2	3	3	3	2	2		3	2	
ELLIS	2	2	2	1	2	1	2	1	2	3	3	2	3	2		2	3	3	3	3	1	1	2	3	2	3	2	4	4	2	2	2		2	2	2	3	3	3		4	4	
ELLSWORTH	1				2	1	2	2	2	3	4	3	3	3	2	2	3	3	3	3		2	2	3	2	3	2	4	3	3	3	3	2	2	2	2	2	3	2	2	2	3	1	2	
FINNEY	2	2	2	1		2	2	2	2	2	3	2	2	3	1	2	4	4	2	3	3	1	2		3	1	3	2	4		2	3	3			2	3	3		2		2		1	2	2
FORD					3	2	3	2	3	2	2	3	2	2					2	2				3	1		3	2								2	2	3	1		2	2	3	2	2	
FRANKLIN			3	1	3	3	2	3	3	5	1	3	4	2		3	2	3	2			2		2	1	3		4	1	2	2	3	3	2	2	3	1	3	2	3		3	1	2	
GRAHAM	2				2	3	2	2	2	3		1	3			2	2	3	2	2				1	3	2	4		4	2	2	2	2				2		2		2	2		2	2	
GRAY			2				2	1	2	2	2	2	3						2			2		2		3		3	4		2	3			2	3		2		2			2	
GREELEY	1		2	1		2	2	2	2	2	2		3					2	2	3			3	2	4		5		3	2	2	2			2	2	4		2		2		5		
GREENWOOD	1				5		2	3	2	2	4	5	2	4	2	2		3	2	3	3			2		3	2	4	2	2	2	2	2			4	2	4	1		2	4		2	1	
HAMILTON	3	3				2	2	3	2			3						2	3	4				3		3	5		2	2	3					2	3	3		3			4	4	
HARPER				2	2	3	2	2	3	2			3	3	3	2			2	3	2	3	3	3		2		2	3	2	4	3	2	2	2	3	2	2	3	5		2	4	3	4	2	
HARVEY	1	2	2		2	2	2	3		3	5	3	4	3	2	3	2	2	3	3				2		3	2	4	2	2	2	2	2	2	3	2	2	3	4	2	3	4	2	3	
HASKEL					1	2	2															3	2	2			2		2	2	2					2	4								
HODGEMAN	2						2	2	2		2	2	3			2	2	2	3	2				3		3	2	4		2	2	3	2			2	2	3			2			3	2	
JACKSON	2	2			2	3	2	3	3	3	5	3	4	3	3			3	2	4	3	1	2	2		2	4		5	3	2	2	3	3	2	2	4	2	4		3	2	4		2	
JEFFERSON	2	3	2		3	2	3	2	3	3	5	3	3	4	3			3	2	3	3			1	2		3	4	2	4	3	1	3	3	3	2	2	3	2	4	2	2	2	3		2	2
JEWELL	3				2	4	2	3	3	4	4	3	3	3	2			3	2	4	3			2	2	3	3	2	5	2	2	2	3	2	3	2	4	3	3		2	2	4	3	3	4
JOHNSON	1	3			4	3	2	2	2	3	5	2	4	4	3			4	3	4	4			2	4	2	5	2	1	2	2	2	2	2	3	3	3	2	5	4		2	2		2	2
KINGMAN	4	2	2	3	3	2	3	3	3	3	3	3	3	2	2	2	4	4	3	3	3	2	3	3	3	2	4	2	4	3	3	3	4	3	1	2	2	4	3	2	2	2	2	2	2
KIOWA										3	3	2	3	3				2	2	1	2	3			2	1	1	4	1	4		2	2	1	2	3	3	2	2	1	1	1	3	2	
LABETTE	2	2	2	2	3	3	3	2	2	4	3	4	3	3				3	3	4	3			3	3		3	2	4	2	2	3	3	3		1	2	3	3	2	2	4	2	2	2	
LEAVENWORTH	2	3			3	2	2	2	2	3	5	2	4	3	3			3	2	3	2			2		2	3	4	4	2	2	3	3	3	2	2	2	3		2	2	3		2	
LINCOLN	2	2			2	2	2	2	3	2	3	4	3	3	3	2	3	3	3	3	3			2	2	2	2	2	4	2	2	3	3	3	2		1	3	2	3		3	2		3	2
LYON	3	3	2		2	2	2	2	2	3	5	2	3	3	3	2		4	3	4	3	1		3	3		2	3	4	2	2	3	3	2	2	2	3	1	2	2	4		2	2		2	2
McPHERSON	2	2	2	2	2	2	2	2	2	3	5	3	4	3	2	2	3	3	3	3	3	2	2	2	3	2	3	4	2	3	3	4	4	2	3	2	3	4	2	4	2	2	3	3	
MARSHALL	2	3			2	3	2	2	2	4	4	2	4	3	2			4	2	4	2			2		2	3	4	2	3	3	3	2	2	2	3	3	2	2	3	3	2	2	3	2	
MEADE	2	2				4		2	2	2	4	4	4					4	2	2				2	2	3	4	3	4	2	2	2	2	2	3	2	2	3	2	2	2	3	2	2	
MIAMI	1	2		3	2	4	3	2	2	2	4	3	3	2	4	2		3	2	3	3	1		2		2	3	3	4	3	2	2	2	2	4	2	4	2	3	3	3	2	2		
MITCHELL	2	2		1	2	2	2	2	2	3	3	1	2	3	2	2	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	3	2	3		2	2	2	2	2		
MONTGOMERY	1	2			2	2		3	2	2	5	3	3	4	2			2	2	4	3			2		2	3		4	1	3	2	5	2	1	1	3		3	3	3	3	3	2	2	
MORTON	3						2	4										1	3					2	2	3					1	1	4											
NEMAHA	2	3	2	2	3	3	2	2	2	3	4	3	4	4	3			3	2	3	3	3	2	2		2	3		4	2	2	3	3	3	3	2	3	3	4	1	3	3	4	2	2	3
NEOSHO	2	2	2	2	4	3	3	3	2	3	4	2	3	4	3			3	3			3	3	4	3	3	3	3	5		2	3	3	3	3	2	4	2	2	2					
NESS	2	2			2		2	2	2	3			2	2	3		2	2	2	2			3		3	2	4	3	3	2	2	2	2			3	3		2		3				
NORTON	2				2	3	3	3		4									3	3	2			3		3	2	4	2	3	3	2			2		2	3			2	3	3	2	1	
OSAGE	2	2		2	3	3	2	3	3	3	5	3	3	2				3	2	3	3			3	2		3	2	4	1	2	3	3	2	2	2	2	3	2	3		2	2	4		3	2
OSBORNE	2	2			3	2	2	3	2	3	3	2	2	2		2	3	3	3	2				2	2	2	3	2	4	2	2	3	4	3	2	2	3	3	4		2	2	2		
OTTAWA	2	2			2	2	2	3	2	3	3	3	2	2	2			3	3	3	2			2	4	2	3	2	4	2	2	3	3	3		2	3	2	3		2	2	3		2	
PAWNEE	2	3		2	2	1	2	2	2	2	4	3	4	1		3	3	2	3	3	3	1	1	3	3	3	2	4	2	2	2	4	3	1	3	2	4	4	2	2	3	2	2	3	
PHILLIPS	2	3			2	3	4	2	3	4		2	2				3	3	3	2				2	2	5		4	3	2	3	3	2	2		2	2	3		2	3		2	3	
POTTAWATOMIE	3	2	2		3	3	2	3	2	3	5	2	4	3	3			3	2	3	2	2	2		3	3		4	2	2	3	3	2	2	3	2	3		2	2	4		3		
RAWLINS	1	2			2	3	2			4		2	2	1				3	2	3				3	2	3	2	5		2	2	2	4			2		3	3						
RENO	3	2	2	1	2	2	3	3	2	3	4	2	3	3	3	4	3	3	3	3	2	1	3	3	2	3	4	3	2	2	5	3	2	2	2	3	4	2	4	2	3	3			
REPUBLIC	2	2		2	4	2	2	3	4	4	2	2	4	3	2			3	3	4	3	2	1	3	2	4	2	2	2	2	1	1	3	2	2	1	3	2	3	3	3	3	3	3	
RICE	2	2		2		2	2	2	2	2	3	3	3	3	2	3	3	3	2	3	3	2	2	2	3	2	4	2	2	3	4	2	2	2	2	4	2	2	2	2	2	2	3		
RILEY	3	2	3		3	3	2	2	2	4	5	2	4	2	3			3	3	3	2	2	1	1		2	3	2	4	2	2	3	3	3	3	2	2	2	1	1	3	2	4		3	1
ROOKS	2				2		2	2	2	3	2	2	2					2	2	2		2	1	3	3	4		2	3	2	2				1	2	3		2	2		2	2		
RUSH		2		1	-		2		1	2	2	3	4	2				3	3	3	3			1	2	2	4	3	4	2	2	3	1			1	3	4	1				3	3	
RUSSELL	2	2	3	2	3	3	2	2	2	3	3	3	3	2				2	3	3	3	2	2	2	2	4	2	2	3	3	3	3				2	4		2	2	3	3			
SCOTT	2	1			2	2	2	3	1			2	2	1				2	2	2				3	3	4		2	2	3	3			2	2	4		2	2			2	3	3	
SEDGWICK	1	3	2	2	2	3	2	3	2	3	5	2	4	3	3	2	3	2	2	2	2			2	3	3	4	2	3	3	3	2	2	2	2	3	3	4	2	3	2				
SEWARD	1	3			2	3	2	3	2	3	4	2	3	3	2	2		2	2	3	3			1	3	2	3	1	4	3	3	2	2	3	2	2	2	3	2	2	2	3	3		
SHAWNEE	2	2			4	3	3	3	3	5	5	3	3	2	3			3	2	3	3			2	3		4	1	1	3	3	3	2	2	3	2	3	2	2	2	3	2	2	1	
SHERIDAN	2				3		2			2			2					2					3	2	2	4		2	2	2					2	5		2							
SHERMAN	2	2	2	2	2	3	2	3	2	3		3	2		1		2	2	3	2				2	2	3		4	1	3	3	2	3		3		2	4		2	2		1	4	2
SMITH	2				3	4	2	3	3	4	3	2	2	2				3	3	3				2	2	3	3	2	4	2	3	3	3	2	2		3	2	3		3	2		3	3	
STAFFORD	2				1	2	2	2	3	2	2	4	3	3	2	2	4	3	2	3	3			2	2	3	3	4		4	3	3	2	5	2	3	2	2	2	4	2	2	2	3	2	
STEVENS																			3	3					2		3										4								
THOMAS	2	2			2	2	3	2	3	3	3		3	3	2			3	4	3	3			3	3	3		4		3	3	4	2		2	2		2						3	2
WABUNSEE	3	2			3	3	2	3	3	3	3	4	2	4	3	3		3	3	3	3		2	2		3	3	2	4	2	2	3	3	3	2	2	2	3	3	4	1	3	2		
WALLACE	3	2			3	2	2	2	2	2		3	1	1				2	2	2	2			2	1	2		2	2	2	2											4			
WASHINGTON	2	3	2	1	3	3	2	2	3	4	4	2	6	4	2		4	2	4	2	1	1	2	2	3	2	2	4	2	2	3	3	3	2	2	4	2	3	1	4	3	2	3	
WILSON	1	2			3	3	2	3	3	2	4		3	3	2			3	2	3	2			2	3	2	4	2	2	3	3	3	2		2	3	2	3	3	2	2	2	2	2	
WOODSON	1	4	1		3	3	2	3	2	2	2	4	2	4	3	2		3	2	2	2			2		2	3	2	4	2	2	3	2	2		2	3	3	3	2	2	4	1	2	1

for the first time in the state so far as known. The aphids which clustered in great numbers on the younger rhubarb stems and leaves checked the growth and rendered the stems unsalable. The aphids reached a peak during June in McPherson, Saline, Dickinson, Riley, Shawnee, Republic, Washington and adjoining counties. The same species of black aphid apparently occurred on beans and tomatoes. These insects were more plentiful on these two garden crops than has been the case for some years.

Pea aphids became abundant on **alfalfa** throughout the state just prior to the first cutting. No damage was done so far as known, partly because the plants were large and vigorous before the aphids became abundant. They were plentiful on the second growth in many localities where the first cutting was made early. Second growth was temporarily stunted in some fields in Riley and Doniphan counties by pea aphids, in spite of some hot, dry weather.

Green bug was widespread in the state on wheat, but no damage was observed in the early spring. They occurred on wheat just prior to the emergence of the heads and probably did some injury at that time. R. H. Painter observed wheat infested with green bug in Riley and Pottawatomie counties during the second week in June.

The **elm leaf aphid** occurred in a serious widespread outbreak on elm trees during June and July in all but the southwestern fourth of the state. The hot, dry period apparently favored aphids and leafhoppers on elms and made the honeydew problem on cars more serious than usual. Many counties in the eastern and central parts of the state reported the elm leaf aphid the most abundant and annoying in recent years. Some observers wondered whether spraying elms for cankerworms had killed the aphid enemies, making possible the large numbers of the leaf aphid. It is entirely possible that this was a factor, but probably not the main cause since the weather favored the species and the state experienced several years with less than normal numbers of this aphid.

R. L. Parker observed white sweet clover in the region of Wathena in mid-June sufficiently infested with a blackish aphid to result in some injury to many plants and the killing of others. It shortened the period of nectar production somewhat.

Other species of aphids observed and reported include aphids on **columbine** and **chrysanthemum** during June; aphids on **spiraea** in June in many areas; aphids on **oak** and **honey locust** trees, both responsible for dropping honeydew on cars; green **peach** aphid during the latter part of April and throughout May in Riley and northeastern Kansas counties. Elbert Eshbaugh reported this species plentiful at Wathena, April 24th. Aphids on **snowball** and **apple** were considerably less numerous in 1948 than in 1947.

Armyworms were considerably less plentiful in 1948 than in 1947. No injury was seen, but their presence was widely reported during the late spring throughout the eastern half of Kansas.

Bagworms were locally plentiful and destructive in 1948. The population in general was fully equal to that of 1947. They were major pests only in the eastern third of Kansas on evergreens in particular, but they also were both seen by the authors and reported in the questionnaires

on apple, elm and certain other plants over most of the state. They were reported as occurring as far west as the Colorado line in the northern three tiers of counties.

Bean leaf beetles were more numerous and injurious during 1948 than in the last five or ten years. They were reported particularly plentiful and injurious in the northwestern counties, the northern two tiers of counties and in the eastern third of the state. The correspondence indicated that insecticide control was widely attempted. As usual, the bean leaf beetles were more destructive on late planted beans than on the early plantings.

Bees had an exceptionally favorable year in 1948 and a large surplus of honey was obtained. The winter loss for the state was normal, but below normal in well cared for apiaries. The colonies increased rapidly for the honeyflow which began in early June and continued into July. There was a good fall honeyflow from smartweed and some other flowers. Swarming was not a particularly severe problem during the spring. Sweet clover bloomed abundantly which provided nectar over a somewhat longer period than usual. The average surplus per colony for the state was 56 pounds, but yields of 100 to 150 pounds of surplus were not unusual. American foulbrood was particularly severe in certain areas, but in general bees went into the winter in excellent condition.

Blister beetles were widely reported in the state but it is believed that they were less numerous and less destructive than in 1947. The population is thought to have been about normal. They were reported causing injury, particularly to garden crops, in widely separated areas of the state, and to alfalfa in southeastern Kansas. The striped species appeared to be the only one of economic importance over most of the state.

Borers continued to be of less than usual importance in the state. Shade trees in general were in good condition because of favorable moisture conditions. Borers were reported, however, in elms at Norton, causing the death of some trees and reducing the growth of young trees materially. It is expected that the large outbreak of cankerworms will have weakened elm trees enough to cause an increase in borer damage in the coming years. Borers were reported in the questionnaire in Chinese elm, locusts, maple, boxelder, plum, cherry and peach from widely separated areas of the state.

Botflies were reported over the state with the larger scorings occurring along the northern border and in northeastern Kansas. Almost without exception, the horse botfly species were indicated in the questionnaires. There is no reason, however, to believe that they were more plentiful in the state than in 1947.

Boxelder bugs were distinctly more plentiful and more annoying in 1948 than in 1947. They were more numerous during both spring and fall, particularly in the months of March and October. They were reported in the questionnaires as causing some injury to boxelder and maple trees and in a few cases to strawberries. The newer insecticides have not proved effective against them.

Cabbage worms occurred in a widespread outbreak throughout the state. While the several species referred to as "cabbage worms" are always plentiful, they apparently were more plentiful than in 1947 and caused more

than ordinary damage in the eastern third of the state and in the northern two tiers of counties.

Cankerworms occurred in one of the largest and severest outbreaks in Kansas for many years. Many cities and towns in the eastern half of the state had their elms more or less completely defoliated. Cankerworm populations were particularly large at Lawrence, Ottawa, Topeka and in some areas as far west as Larned. The fall cankerworm moths began emerging about the middle of February. At Manhattan, only a few moths had emerged by February 25. At that time, the buds were just starting to swell. By the first week of April, the spring cankerworm moths had largely completed emergence. The numbers of moths caught on the sticky bands at Sedan, Winfield, Eldorado, Marion, Salina, Junction City, Manhattan and Topeka were larger than last year.

There was a heavy seed crop on the elms which concealed the damage by the small cankerworms to the young leaves so that the delay in leaf emergence was not noted by many residents. The presence of the larvae was unnoticed in many localities until they were halfgrown or larger. The defoliation, therefore, was almost complete in many areas. Many towns sprayed their elm and hackberry trees and a few cities employed airplane operators to spray their trees with DDT. It is believed, however, that much of this spraying was done too late or after the major cankerworm damage was largely completed. By the middle of May, the cankerworms were fully grown and the leaves began to appear. Elms in general put out good foliage after the outbreak. It was noted that in towns, such as Manhattan, where efforts had been made over a period of years to control cankerworms that the defoliation was far less severe than where control efforts had been neglected in previous years.

Cattle grubs were widely reported throughout the state, but there is no reason to believe that they were more numerous than in 1947. The scorings and reports lead one to believe that they were probably slightly less numerous than in 1947. They still constitute a major problem in pasture cattle from the southwestern states. Kansas grown cattle now have few grubs, according to the extension entomologist. Derris spraying campaigns for their control in December were widely undertaken.

Carrot weevils were scored at 2 or 3 in 19 northeastern counties in 1948. They ranged from Doniphan to Linn and west to Morris county. The authors believe that the carrot weevil problem is increasing in severity in the state.

Chinch bugs were scarce throughout the state in 1948 and few chinch bug barriers were made to keep them out of corn fields. These insects were reported, however, from practically every county in the state as far west as a line drawn between Phillips and Edwards counties, with isolated occurrences to the western border. Vocational agriculture supervisors reported them abundant in the Flint Hills region during early June in Osage, Neosho, Butler and Reno counties. They were observed by R. H. Painter to be scarce in Rice, Reno, Riley and Marion counties in early June. A small population of chinch bugs went into hibernation in the fall. The wet weather at that time apparently was unfavorable for them. They were

reported as occurring on sorghums in the fall in Sedgwick, Miami, Johnson, Washington, Jewell, Barton, Edwards and Thomas counties.

Cicadas were less numerous in Kansas than in 1947, since the 17-year species was virtually absent. However, the two-year species continued to be plentiful and their singing was particularly noticeable until near the end of July. Their molts were exceptionally plentiful on shade and fruit trees in Kaw Valley counties during the late summer and early fall. Elbert Eshbaugh reported injury to apples by adults, both in 1947 and 1948. The adults punctured the skin of the apples, particularly around the stem, causing severe scars and rot. The injury was not unlike that of codling moths or curculio. So far as known, this is the first report of cicada injury to apples. As many as 13 to 17 punctures occurred on many apples. The punctures were clustered and generally deep into the pulp. Several dozen adult cicadas often were observed in some apple trees.

Codling moths in general were probably less numerous in the apple growing sections of the state, but since there was a small fruit crop, their injury was severe in neglected orchards. Many growers followed an abbreviated spray program. The first brood of moths was reported by Elbert Eshbaugh to be 50% complete on May 21 and the second brood began emerging about June 25. The first cover spray was completed about May 15.

Colorado potato beetles continued during 1948 to be low in numbers but there was evidence of a slight increase in the state. More growers, including gardeners, applied insecticides for the control of these pests in 1948 than in 1947.

Corn borers. The European corn borer was found in four additional counties during 1948, namely, Anderson, Doniphan, Franklin and Woodson. The complete list of the 16 counties in Kansas in which the European corn borer was found during 1948 is as follows:

Anderson	Doniphan	Johnson	Osage
Atchison	Douglas	Leavenworth	Shawnee
Bourbon	Franklin	Linn	Woodson
Coffey	Jefferson	Miami	Wyandotte

The surveys were made merely to determine which counties were infested and not the general degree of infestation. In general, it is believed that sweet corn had fewer borers per stalk or per acre than in 1947. Borers were found both in sweet corn and field corn. No injuries of consequence were seen or reported.

Southwestern corn borers spread a county width eastward from the area known to have been infested in 1947. Surveys made by H. H. Walkden of the Bureau of Entomology and Plant Quarantine showed the borer to be present in Chautauqua, Cowley, Butler, Marion, Saline and Cloud counties on the eastern border of the infested area, and Mitchell, Barton and Edwards counties on the western border. No corn was found in Comanche, Kiowa and Pawnee counties, all of which have been infested heavily for several years. This confirms the trend of discontinuing growing of corn in areas previously heavily infested with this borer. The counts show slightly heavier infestation per stalk along the eastern and western borders of the infested area. The heaviest infestation occurred in the fol-

lowing counties, beginning with the most heavily infested: Stafford, Edwards, Pratt, Barton, Rice, Reno, Barber, Harvey, Sedgwick, and McPherson counties. In the questionnaire reports, Finney and Sumner counties also were reported as counties with high infestation.

Corn earworms were less numerous and less destructive throughout the state in 1948 than in 1947. The tremendous corn crop was not severely damaged by corn earworms though these insects were readily found, particularly in the late planted corn, and the large number of 3's in the summary numbers indicate the counties in which these insects were plentiful. Washington, Marshall, Johnson and Lyon counties were scored at 4. Corn earworms were rather extensively reported as present in the heads of sorghum, including milo, in the late summer. Some damage was done to this seed crop. Infestation was also reported from popcorn and, of course, the infestation in sweet corn was general. These insects were scarce in alfalfa throughout the season.

Corn rootworms continued to be plentiful and caused damage in the early part of the summer of 1948. A feature of the year was the increase in population and damage by the western corn rootworm (**Diabrotica virgifera** Lec.) in the vicinity of Smith, Jewell, and Phillips counties. D. A. Wilbur and H. R. Bryson visited the area and found some fields in which the stand of corn was materially affected by this insect.

Crickets continued at a high level in population during 1948. Most of the counties were scored at 2, but about one-third of the central Kansas counties were scored at 3, and Thomas County at 4. Crickets were particularly plentiful in fields, but were reported about as plentiful as usual in homes during the hot, dry summer.

Clover leaf weevils, while normal at least in Riley County, were found by Kling Anderson to be exceptionally numerous in fields of Ladino clover in the Lawrence area. He reported that some fields had bare spots due to feeding by the larvae of these weevils. Reports were received during April of some injury, and more than normal numbers of clover leaf weevil larvae were sent in from other areas in eastern Kansas.

Corn billbugs were observed and reported only in Riley County. Typical injury was observed on May 17 in a river botton field of corn.

Colaspis larvae occurred particularly on corn in Johnson County where the extension entomologist stated they occurred in injurious numbers in several fields. These beetles seem to be increasing in numbers in the state and becoming more injurious. Stalks of corn severely attacked in early June failed to recover.

Dendrothrips ornatus (Jabl.) (determined by Bureau of Entomology) was collected in Kansas for the first time on privet. The authors were informed that this is an introduced species from Europe, which is often highly injurious to the foliage of this plant.

Diaspis echinocacti (Bouché), the cactus scale, was sent in from a green house in eastern Kansas during the year. It was identified by H. Morrison. This might be a first report for this species in Kansas.

Cucumber beetles were reported, as usual, from virtually every county. The large number of 3 and 4 scorings indicates that they were slightly

more plentiful throughout the state in 1948 than in 1947. Early cucumbers produced a crop in many areas without the use of insecticides, but late plantings generally were injured severely.

Cutworms were widely reported in gardens and alfalfa fields throughout the state in 1948 but they were probably no more numerous than in 1947. They were scored at 4 only in Doniphan and Hamilton counties, attacking garden plants and flowers. Cutworms did not do serious damage to alfalfa fields, but widespread injuries to garden crops were reported in the early spring.

The **elm calligrapha** was no more numerous in 1948 than in 1947. In fact, it is believed that in most counties, the species was less numerous. They occurred only in southcentral Kansas and in the Kansas River Valley. Little if any spraying for the control of these insects was done during 1948.

Elm seed wing midges were apparently scarce in Kansas during 1948. The larvae were seen, however, in considerable numbers at mid-April in a bird bath under an elm tree in Riley County. They were sent in also by Dr. F. W. Koons from Halstead on April 7. The elm seed crop was mature at Manhattan about April 12. The midges were probably more numerous than these two observations indicate.

Fall armyworms were reported widely in the state but did no damage so far as is known. The population in general was equal to that of 1947. Their distribution was confined largely to the eastern and central parts of the state where they occurred in corn and alfalfa fields.

Fall webworms were fully as plentiful in 1948 as in 1947, chiefly in the eastern two-thirds of the state. In fact, it is believed that the webs occurred in larger numbers in fruit and shade trees during August and September than in previous years. Little real damage, however, was done.

False wireworms continued to increase during 1948 and they were more plentiful in the western two-thirds of the state than in 1947. An outstanding feature of the year was the presence of the extraordinarily large numbers of false wireworm adults seen running about on the ground in many counties during July. This was observed in Ottawa, Saline, McPherson, Ellis and a few other mid-western counties. Somewhat more injury to wheat was reported during September and October from western Kansas counties than for several years. The dry summer and fall favored damage by these pests, but growers in general postponed sowing wheat in many cases until mid-November when moisture conditions were more nearly adequate for prompt germination.

Fleas in homes and on pets were reported widely in the state as about equal to numbers present in 1947, and no unusual manifestations developed during the year.

Flies on livestock were more numerous and more annoying during 1948 than in 1947. Both horn flies and stable flies were scored at 3's and 4's for the majority of the counties. There was wide-spread spraying of cattle and barns during the year. The newly discovered resistance of flies to DDT may have occurred in the state for the first time during 1948. However, reports of poor results from this standard method of control have been

due in part to the high rate of fly reproduction resulting from neglect to follow recommended sanitary measures and the use of too low strength DDT sprays.

Horseflies (Tabanids) were almost absent during 1948 throughout the state. The population was far below that of the previous year. Planned control experiments could not be conducted because of a lack of these flies in areas where they generally have been numerous. It is possible that the heavy rains and floods during May and early June carried the tabanid larvae downstream and drowned the pupae in the banks of streams.

Screwworm flies were probably equal in numbers to those reported for 1947. They occurred sporadically throughout the season but actually few reports of their presence were received. The extension entomologist scored them at 3 from Johnson, Douglas, Franklin, Osage and Woodson counties, and at 2 for Sedgwick and Ford counties.

Garden webworms were far less numerous and less destructive in 1948 than in 1947. There was a sharp drop from the previous year to something approaching normal conditions. They were not a factor in any part of the state, though they were reported widely in the questionnaires from the central and southern counties.

Grasshoppers increased markedly in numbers during 1948 over the previous year. At the close of the year, grasshoppers were the most threatening pest to crops for 1949 and the questionnaire reports fully supported the survey results and predictions of the Bureau of Entomology and Plant Quarantine in Kansas. The summary numbers for the counties of the state are practically all 4's with a few 5's, particularly in border counties.

F. D. Butcher reported that the grasshopper hatch was well along in western Kansas on May 27 but had not been completed. The weather during the spring was exceptionally favorable for grasshoppers though some reduction in egg viability occurred in southwestern counties due to dry weather. By early June, grasshoppers were beginning to assume threatening numbers throughout the state. Conditions resembled those of the thirties. Increased numbers of young grasshoppers were observed in both eastern and western Kansas. R. H. Painter observed oats heads severed by grasshoppers in the Wichita district. He reported as many as five per yard of migratory grasshoppers in alfalfa.

Aelopus turnbulli has definitely increased in western Kansas, and the first adults of the season were observed on June 12th.

An opportunity to make control tests was provided by the first Riley County outbreak in 1948 which occurred in a sweet clover field near Manhattan in the early days of June. Both nearly grown nymphs and adults of the migratory species were present in larger numbers than had been seen in this region for perhaps five years. Similar heavy infestations, quite local in area, occurred in many parts of eastern and central Kansas. They were observed specifically during the latter part of June in the vicinities of McPherson, Salina, Beloit, Belleville, Concordia, Washington and Waterville. They were reported invading fields and gardens in the region of Hays by Jewell Gebhart during mid-June, and caused severe damage to

many kinds of garden plants. Mr. Butcher observed a large hatch of second generation migratory grasshoppers in western Kansas from Tribune to LaCrosse on August 20. Fields of volunteer wheat had begun to show typical margin injury by grasshoppers. Many large grasshopper flights were observed by Mr. Butcher in Finney and other western Kansas counties during the middle and latter part of September. They alighted in wheat fields and remained. The hoppers scattered somewhat uniformly in the fields, even those with little vegetation.

When the wheat came up, these scattered grasshoppers caused serious damage to young wheat in the western two tier of counties, and they were difficult to control because of the lack of concentration. Eggs were distributed in the field instead of being concentrated. Some of the flights stopped in fields only long enough to cause injury and then proceeded to other fields. The egg survey in the fall indicated large numbers in the ground throughout western Kansas counties, largely of **mexicanus.** This appears to be practically the only species represented in threatening numbers. The extension entomologist stated that the prospects for an outbreak equal to 1936 were good.

Chlordane and Toxaphene were used over large acreage in Kansas in grasshopper control for the first time in 1948. Excellent results were reported from the sprays applied to succulent vegetation where grasshoppers were concentrated. Poison baits were used extensively around fall-sown wheat fields.

Hackberry psyllids were exceptionally plentiful during 1948 and again were observed during the early summer on screens and in homes. The psyllid adults again were common on screens in Riley County the latter part of October and in early November. This was only the second year in the memory of the authors that this occurred at Manhattan. There was a heavy crop of galls on most hackberry trees.

Hessian fly was present in relatively small numbers during 1948 on both the harvested wheat crop and the fall sown crop. Throughout the year, they were present only in scattered fields. No real damage was done either to the "miracle" wheat crop of 1948 or to the extensive acreage sown in the fall, generally planted after the safe date because of the dry fall. The summary numbers computed from the questionnaire reports differ somewhat from the harvest survey results recorded by the Bureau of Entomology and Plant Quarantine. Those data indicated that the Hessian fly population in the southeastern counties was larger when compared to adjoining areas than is shown in this summary. Hessian fly was present only sporadically in counties west of a line drawn from Phillips to Edwards counties.

Leafhoppers were less numerous in 1948 than in 1947, but were present in destructive and annoying numbers in September. They were reported from most counties, but the larger scorings occurred in the eastern and central portions of the state. They were reported on potatoes in Phillips, Ellis, Reno, and Riley counties; on grape and English ivy or woodbine in September in Thomas and Doniphan counties, and on alfalfa in Ellis and Neosho counties. Woodbine foliage was so heavily infested and damaged

by leafhoppers by mid-September in Doniphan and Riley counties that it appeared grayish, and the leafhoppers were actually annoying to people where attracted by lights. This condition was not general, however.

Mosquitoes were more numerous and more annoying during 1948 than in several previous years. The heavy rains in the early summer were favorable for them. The numbers declined slightly during the summer, due to the heat and drouth, but increased again in the late fall. Two central Kansas counties were scored at 5, seven central and western counties at 4, and most of the remaining counties of the state at 3. They were exceptionally numerous in Riley County during May and June.

Mites had distinctly larger populations in 1948 than in 1947. They attained damaging numbers on evergreens in June and July in many areas of the state in spite of heavy, early rains. The dry weather the latter part of June, together with the control measures employed, reduced both numbers and injury. They were not plentiful on apple trees at Wathena in late summer.

Chiggers were not particularly numerous during 1948. They were scored at 2 or 3 over most of the state. Less necessity for control measures occurred than normal. They had practically disappeared in the state by mid-September. No letters or newspaper articles were noted on this subject during the summer.

Rose sawflies were approximately as numerous and annoying in 1948 as in 1947, though both numbers and damage were still below normal.

Plant bugs, chiefly the tarnished and rapid species, were somewhat less numerous in 1948 than in the previous year. There were few blossoms in alfalfa at the time of the first cutting which was harvested as hay in early June.

Alfalfa plant bugs again were noticeably plentiful. The first generation matured about June 4 in Riley County. The increase of this species in the state during the last six or eight years has been remarkable.

Red-banded leaf-rollers occurred in damaging numbers in northeast Kansas orchards during mid-September, according to Elbert Eshbaugh.

Scale insects were fully as numerous and troublesome as in 1947.

European elm scale populations in western Kansas counties were reduced materially by spraying with miscible oil and DDT. The heaviest infestation still occurred at St. Francis. Infestation of elms in Colby, Sharon Springs, and Goodland were markedly reduced by the end of the year. No new infestations were reported.

Forbes scale increased in the apple growing region in northeast Kansas, particularly where DDT was used in codling moth sprays. In one orchard where DDT had been used for three years, practically every apple showed 1 to 20 Forbes scales around the stem. Miscible oil applications were made to infested trees for the control of this scale in 1948 for the first time in many years.

San Jose scale appeared to have increased in orchards during the year.

Silver-spotted skippers were especially plentiful during late summer in Riley County. Wistaria vines were generally infested and in some cases largely defoliated. They also attacked the foliage of "rose acacia" severely.

More than the usual number of letters were received about this insect during the late summer, many of them including specimens of the larvae.

Sorghum midges caused more blasting of the heads of sorghum in Kansas in 1948 than ever before had been observed. Damaged heads were sent in from Coffeyville, Cedar Vale, and Haviland. These were the only reports of damage received, according to H. R. Bryson, for about 20 years. The midge attacks Johnson grass, grain sorghums, sudan grass, sweet sorghums, and broom corn.

Southern corn leaf beetles (Myochrous denticollis Say) [illegible]ed in a severe outbreak at St. Marys in corn during the first week o[illegible] D. A. Wilbur surveyed the damaged area and found that the adults commonly ate through the mid-rib of the leaves, causing many leaves to break off while others, though full of holes, remained attached. The beetles also ate into the sides of many stalks, causing them to fall over. The more severely damaged plants died, making replanting necessary. J. C. Munson stated that the last previous outbreak occurred in this region about 1915.

Spinach flea beetles were sent in from Bonner Springs the latter part of April, where they were reported causing serious injury to this crop.

Squash bugs were probably less plentiful in 1948 than in the previous year. Many persons, at least in Riley County, produced a good crop of squash without the application of insecticide.

Stored grain insects were more numerous and destructive in 1948 than in 1947. They were reported at 4 in many western and central counties. It is believed that infestation was general throughout the state, but was especially bad in old wheat.

Dr. R. T. Cotton has summarized his observations and those of his staff as follows: "Reports of insect damage to stored grain have been more numerous during the past year than usual. Observations on the insect population of stored wheat in untreated farm bins in two counties in south central Kansas showed an increase from an average of 5.6 insects per 1,000 gram sample in July to 44.2 insects per 1,000 grams in October. Altogether 13 species of grain-infesting insects were found in farm stored grain during 1948, of which the flat grain beetle was most abundant. The granary weevil, rice weevil and lesser grain borer were more abundant than usual. The fungus beetles (hairy fungus beetle and the foreign grain beetle) were also more abundant than usual, due largely to the presence of high moisture grain."

The county scorings of stored grain insects indicate that these pests were factors in every county of the state. There was more correspondence on methods of fumigating grain and the treating of grain bins during the early spring than for many years. It was reported that there was twice as much wheat in storage in the preharvest period as in 1947. All reports referred to wheat, except oats was mentioned in Brown County and sorghum seed in Coffey and Hodgeman counties.

Strawberry leaf rollers were observed to have been common only in Doniphan County and at Concordia the latter part of June. They were regarded as normal in numbers.

Sweet clover weevils were collected in Rawlins County on September 6 by Clarence H. Sooter. He collected 8 adults five miles north of Atwood, but reported finding the species for the first time in Kansas in the same place in 1947. This species has been reported as having been taken near Topeka in 1947, but no specimens are available to confirm this report. It has caused serious damage in the region of Lincoln and Omaha, Nebraska.

Tent caterpillars were observed in small numbers in the Kaw Valley.

Tomato horn worms were reported in large numbers only in the south-central part of Kansas and in the northern tier of counties. They were almost absent in Riley County until early fall.

Thrips were not particularly numerous in the state during 1948 but gladiolus plants were found to be heavily infested and injured at Clay Center. Ladino clover in the Lawrence area was observed by Kling Anderson to have serious foliage damage by thrips. Some of the leaves were killed and others were crinkly, folded and typically white-blotched.

Walnut worms occurred in a well defined outbreak in the central third of the state and in the Kaw Valley. The extension entomologist scored walnut worms at 5 for July in all counties in this area. Many letters were received about this pest, and large numbers of trees were partly or completely defoliated, either by the first or the second generation.

The **wheat strawworms** and **wheat stem maggots** were as readily found in fields in 1948 as in 1947. They may not have been more plentiful, but R. H. Painter reported them as being more conspicuous than in 1947. No real damage was seen or reported.

White grubs were fully as abundant and destructive as in 1947. The garden species were fully as plentiful and destructive as normal, which means that damage was readily observed. The lawn species were also plentiful, but good rains during the spring and early summer kept injured lawns alive so that relatively few lawns were lost. R. H. Painter scored wheat white grubs at 4 in Wilson County. The extension entomologist scored the **cyclocephala** white grubs at 4 in 16 western counties, beginning at Russell, and extending as far south as Kiowa, and as far northwest as Decatur and Cheyenne counties. Many reports of damage to wheat were received during the year from western Kansas counties.

Wireworms were less numerous in 1948 than in 1847. Throughout eastern Kansas they were scored at 1 or 2 and were reported chiefly attacking corn and sorghums. A few scattering counties in central and western Kansas were scored at 4, some at 3, but the majority at 2. The scorings in eastern Kansas are understood to refer to the true wireworms, while those in western Kansas refer most likely to false wireworms.

SUMMARY AND CONCLUSIONS

Flora (1949) stated in part that the year "1948 had exceptionally favorable crop growing weather, with a summer that was considerably cooler than usual and a long stretch of fine Indian summer weather in the autumn." "The state had almost record-breaking snowfall." "The year's precipitation was above normal in almost every part of the state and occurred at opportune times for crops." "Almost half the year's rainfall came

in June and July." "The year averaged the coolest the State had experienced since 1929."

The following insects and related forms occurred in the state in **outbreak** numbers during 1948: aphids on rhubarb, elm leaf aphid, cabbage worms, cankerworms, southern corn leaf beetles, and walnut worms.

The following species, in addition to those listed above, were **more numerous** during 1948 than in 1947: bean leaf beetles, box elder bugs, Colorado potato beetles, European corn borer, southwestern corn borer, clover leaf weevils, cucumber beetles, elm seed wing midge, fall webworms, false wireworms, flies on livestock, grasshoppers, stored grain insects, hackberry psyllids, Forbes scale, San Jose scale, mosquitoes, two-spotted mites, silver-spotted skippers, sorghum midge, gladiolus thrips, and red-banded leaf roller.

The following species were **as plentiful** in 1948 as in 1947: ants in general, green bugs, bagworms, bot flies (horses), carrot weevils, two year cicadas, corn rootworms, crickets, cutworms, fall army worms, fleas in homes and on pets, screwworm flies, rose sawflies and white grubs.

The following species were **less plentiful** in 1948 than in 1947: pea aphids, aphids on columbine, chrysanthemums, spiraea, snowball, oak and apple, army worms, blister beetles, borers in trees, cattle grubs, chinch bugs, codling moths, corn billbugs, colaspis sp., elm calligrapha, European elm scales, garden webworms, leafhoppers, plant bugs, chiggers, squash bugs, tomato horn worms and wireworms.

The following species were **scarce** or had extremely low populations in 1948: periodical cicadas, horse flies, and Hessian flies.

AN OBSERVATION ON THE EGG-LAYING OF CUTEREBRA BUCCATA FABR. IN NATURE

R. H. BEAMER
University of Kansas, Lawrence.

(Diptera-Cuterebridae)

On Friday, June 3, 1949, about one mile southwest of Ottawa, Kansas, I found a female **Cuterebra buccata** resting on a branch of a cedar tree. I captured it without difficulty with my hands and secured it alive in a handkerchief. As I moved on about fifty yards to some other trees, I observed another female of this same species flying less than a foot above the ground. Every few seconds she alighted on the tip of a grass blade and remained there a second or two. After several such performances I marked the last grass blade and when next she alighted I captured her and collected the grass blade she had just left. I found two eggs side by side at the very tip of this blade. The course of the various egg-layings had been along an auto or truck track which would make a very nice runway for rabbits. The selection of this natural runway was probably just chance although it seems possible that it could have been selective.

The two specimens were brought to the laboratory where they laid numerous eggs in the next ten days.

A NORTHERN SUBSPECIES OF EACLES IMPERIALIS (LEPIDOPTERA, SATURNIIDAE)

CHARLES D. MICHENER[1]
University of Kansas, Lawrence

The imperial moth (**Eacles imperialis** Drury) occurs in a series of subspecies ranging from southern Canada to Argentina. For years certain lepidopterists have known that some Canadian specimens were smaller and more heavily dotted with black than the average **imperialis** from the eastern states, but the differences seemed so slight that no name was applied to this form. Recently material has been assembled in connection with a revisional study of the genus **Eacles** which more clearly emphasizes the distinctive biological and color characters of the northern form, which is described as follows:

Eacles imperialis pini new subspecies

Size smaller than usual in typical **imperialis**, particularly in female, length of forewing in male 47 mm. (45 to 48 mm. among paratypes), in female 53 mm. (47 to 54 mm. among paratypes); dark markings pink to pinkish brown, decidedly more pink and less brown than in typical **imperialis**; postmedian line of forewing usually separated from premedian in male as well as female (in male of typical **imperialis** these lines meet in cell Cu_2 of the forewing in about 80 per cent of the individuals); postmedian lines of both wings well defined on under surface in both sexes; dotting on both upper and under surfaces of wings heavier than in **imperialis** (lighter in figured specimens than in many paratypes). Apex of male harpe usually more slender and less bulbous and tumid on outer side than in typical **imperialis**.

Larval host: Pine (**Pinus strobus** and **P. banksiana**).

Holotype male: Cheboygan County, Michigan, August 4, 1947 (Bernard T. McDermott). Allotype female and seven male and one female paratypes: Cheboygan County, Michigan. One male paratype, same locality, June 30, 1947 (Rosemary Eliot); one male paratype, same locality, July 5, 1940 (Ray Williams); one male paratype, same locality, July 5, 1948 (Flora Gorirossa); one female paratype, same locality, July 4, 1948 (Mary Creager); one male paratype, same locality, July 4, 1935; one female paratype, same locality, July 6, 1933 (C. D. LaRue); four male paratypes, same locality, July 12, 1949 (H. B. Hungerford); three male and one female paratypes, same locality, July, 1949 (H. B. Hungerford); one female paratype, same locality (Burt Lake), June 24, 1932 (M. M. Peet); one male paratype, same locality, July 14, 1934 (most of the above specimens came from the vicinity of the University of Michigan Biological Station at Douglas Lake, some having been reared from larvae found on pine); fifteen male and two female paratypes from near Oscoda, Iosco County, Michigan, July 18, 1949 (Elwyn Lewis).

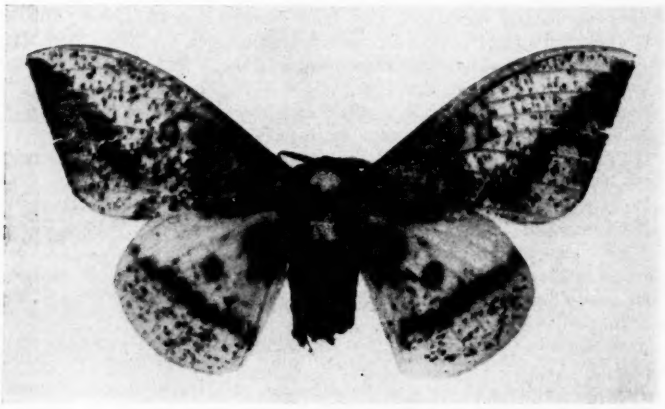
[1] I am indebted to the late Frank Johnson of Giffin, Georgia, for the opportunity to use his excellent collection of Saturniidae and for funds which have made possible the saturniid studies of which this paper is a part.

I also wish to thank Doctor H. B. Hungerford and Mr. Elwyn Lewis for assembling most of the Michigan series of **E. imperialis pini**; Doctor T. N. Freeman for the loan of Canadian specimens, and Doctor T. H. Hubbell for making available a fine series from many parts of the United States.

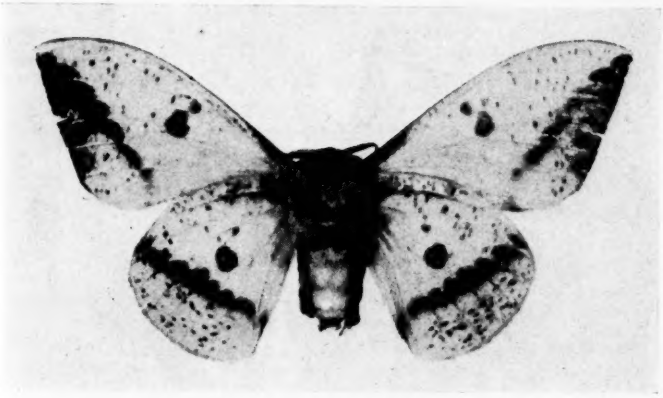
1. Map showing known localities for **Eacles imperialis pini** as dots and the northernmost known localities for **Eacles imperialis imperialis** as crosses.

The holotype and allotype will be placed in the collection of the American Museum of Natural History. Paratypes will be deposited in that collection and in the Canadian National Collection, the Snow Entomological Museum, the Elwyn Lewis collection, and the collection of the University of Michigan.

Mr. Elwyn Lewis of Flint, Michigan, has kindly communicated some interesting information about **pini.** He states that in Iosco County, Michigan, it is on the wing from the middle of June to the middle of July. He has reared many larvae to maturity, both on **Pinus strobus** and **P. banksiana,** although one group of larvae seemed to show a preference for the latter after they were a few days old. A larva feeding on white pine is figured by



2. Upper side of holotype of **Eacles imperialis pini.**

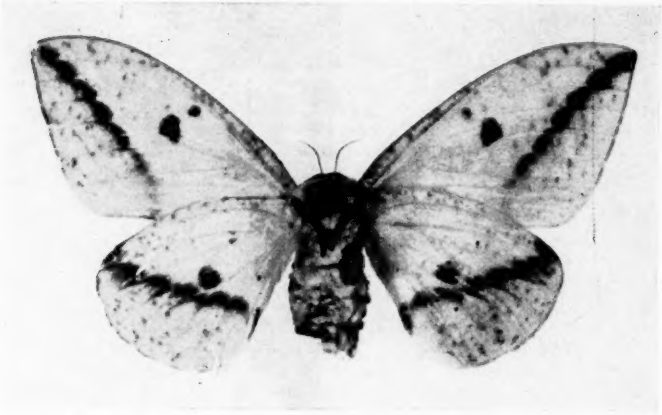


3. Under side of holotype of **Eacles imperialis pini.**

McDaniel (1932, Circular Bull. 141, [Michigan] Agr. Expt. Sta., p. 1).

Specimens of **pini** in the Canadian National Collection from Norway Bay, Quebec, June 23 to 28, 1938 and 1939, some of them reared from larvae found on white pine by G. A. Hobbs, are not made paratypes because of the darker markings, although these markings are pinker than in typical **imperialis** and other characters are as in **pini.** According to Doctor T. N. Freeman, the population at Ottawa, Ontario, is similar and so far as known feeds exclusively on pine. A specimen of the subspecies **pini,** kindly lent me by Doctor T. H. Hubbell of the University of Michigan, is from six miles

4. Upper side of allotype of **Eacles imperialis pini.**



5. Under side of allotype of **Eacles imperialis pini.**

northwest of West Fort Ann, Washington County, New York, August 6, 1932 (J. R. Bailey). Although this locality is only about fifty-five miles from Albany, where typical **imperialis** occurs, it is at a much higher altitude.

E. imperialis pini occupies an area at one end of a series of subspecies and as might be expected from its geographical position, exhibits extremes in several respects.

It is smaller than other subspecies except those of temperate South America. The length of the forewing of the male in a series of **pini** averages about 47 mm.; in a series of twenty **imperialis** from New York City and vicinity (obvious dwarfs excluded) it averages about 54 mm. In the female the few available **pini** specimens average 51 mm., while the average of ten New York City specimens (dwarfs excluded) is about 60 mm. with a maximum of 72 mm. Because of their small size and rather heavy maculation, the females of **pini** look more like the males than in other races.

The dark markings are pinker than in any other subspecies; **imperialis** proper is intermediate in this respect, and Latin American subspecies have dark brown markings. The presence of postmedian lines on the under surfaces of the wings characterize the temperate zone races in both hemispheres. These lines occur in all specimens of **pini,** in less than 50 per cent of the specimens of **imperialis** proper from the latitude of New York City, and in virtually none of the specimens from the southern states or tropical America, but reappear in Argentina. Heavy dotting may occur sporadically at least as far south as Chiapas, Mexico, and a very heavily dotted specimen from New York City was given the aberrational name **punctatissima** Neumoegen. The dotting of **pini,** however, is heavier for the entire population than in other subspecies.

The most interesting character of **pini** is the host plant of its larva, which so far as known is invariably pine. Other subspecies feed on a very

wide variety of broadleafed trees and shrubs. **E. imperialis** proper ordinarily does not feed on pine, even in the northern part of its range, and Freeman **(in litt.)** mentions finding it on **Juglans** at Simcoe, Ontario. However, it does sometimes feed on pine, at least as far south as Pennsylvania (see Gentry, 1874, Canad. Ent., vol. 6, p. 87), and I am told that it feeds on pine in addition to broad leaved trees in the Carolinas and Georgia.

A RECORD OF JADERA HAEMATOLOMA (H.S.), (HEMIPTERA, COREIDAE), ATTACKING SOAPBERRY, (SAPINDUS DRUMMONDII H. & A.), IN KANSAS

R. B. SCHWITZGEBEL,
Bureau of Entomology and Plant Quarantine,
Agricultural Research Administration,
United States Department of Agriculture

A resident of Hutchinson, Kansas called the author's attention to a soapberry tree, **Sapindus drummondii** H. & A., which was being attacked by **Jadera haematoloma** (H.S.)[1]. At the time of the observation, July, 1944, the adults and also the nymphs were present in large numbers on and near the tree. The owner was not only concerned about the welfare of the tree, but also wanted to get rid of the insects since they were becoming a nuisance by entering the nearby houses and basements and crawling on the adjoining walks, shrubbery, and porches.

It was advised that the owner of the tree use a spray containing about four times the amount of nicotine sulfate as that usually recommended for aphid control. Several applications of this material around the base of the tree and in the surrounding yard and shrubbery reduced the population to a low level. No attempt was made to spray the entire tree which would have been necessary in order to prevent damage to the foliage by this bug. The tree sustained some injury as a result of this attack as evidenced by its sickly appearance throughout the remainder of the growing season.

No published record of the occurrence of this insect on soapberry in Kansas is known to the writer. However, this species is represented in the collections of the Kansas State College and the University of Kansas by specimens which were taken in Riley, Cloud, Decatur, Morton, and Hamilton counties in Kansas, and also from Lawton, Oklahoma. No host plant records accompanied these specimens.

Sanderson[2,3] observed that **J. haematoloma** was frequently found on cotton bolls and did some damage; and both adults and eggs were found on chinaberry, a local name for **Sapindus** in Texas. Pierce[1] mentions that this insect is capable of damaging cotton.

LITERATURE CITED

[1] Pierce, W. D., 1917. How insects affect the cotton plant and means of combatting them. USDA Farmer's Bul. 890, p. 21

[2] Sanderson, E. Dwight., 1905. Miscellaneous cotton insects in Texas. USDA Farmer's Bul. 223, p. 21.

[3] ————, 1906. Miscellaneous cotton insects in Texas. USDA Bul. 57, p. 47.

[1] Identification made by R. I. Sailer of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, Washington, D.C.

A COMPARISON OF THE GRASSHOPPER KILLING EFFECTIVENESS OF CHLORDANE, TOXAPHENE, PARATHION, AND COMPOUND 118 SPRAYS and SODIUM FLUOSILICATE BAIT IN KANSAS IN 1948[1]

FRED D. BUTCHER,[2] DONALD A. WILBUR,[3] and PAUL A. DAHM,[3]
Manhattan, Kansas

The following discussion concerns three separate tests made cooperatively by personnel of the Bureau of Entomology and Plant Quarantine and of the Department of Entomology, Kansas State College. Two tests were conducted in western Kansas and compared three of the new insecticides with a sodium fluosilicate bait; the other test was made in eastern Kansas using only the four new insecticides. The western Kansas tests were made in Finney County in the Arkansas Rivey Valley during late June and repeated in August. The insecticides included in these tests were chlordane, toxaphene, parathion used in sprays and sodium fluosilicate used in bait. The eastern Kansas test was conducted in Riley County in the Kansas River Valley during September; the insecticides used were chlordane, toxaphene, parathion and a compound bearing Julius Hyman and Company's number 118.[4] The June tests were made when the vegetation was rank and succulent in contrast with the August and September series which were made after the vegetation had ripened and had started to dry.

Western Kansas Tests, June 1948

The June 17-25 tests in Finney County consisted of five replicates, each with five plots. Each plot consisted of a roadside strip one rod wide and one-half mile long with an area of approximately one acre. These plots had a luxuriant cover of grasses and weeds due to the ample rainfall of May and June. The most common weeds on the 25 plots were lamb's quarter, Russian thistle, fire weed and sunflower and less plentifully, pig weed, wild lettuce, giant ragweed, and sweet clover. Frequently the sunflowers and sweet clover exceeded six feet, the lamb's quarter, fire weed and wild lettuce four feet and the Russian thistle three feet in height. Under these vegetative conditions, grasshopper control by means of bait has been reported to be unsatisfactory.

The grasshopper population was composed of several species, of which the lesser migratory grasshopper, **Melanoplus mexicanus mexicanus** (Sauss), the two-striped grasshopper, **M. bivittatus** (Say), the red-legged grasshopper, **M. femur-rubrum** (Deg.), the differential grasshopper, **M. differentialis** (Thos.), the thistle grasshopper, **Aeoloplus turnbulli bruneri** Caud. and **Hesperotettix speciosus** (Scudd.) were the most abundant. The population density averaged eight grasshoppers per square yard for the 25 plots. The highest population of 40 grasshoppers per square yard was found in an area of tall sweet clover and consisted largely of nymphs and adults of **M. femur-**

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[1] Contribution No. 569, Department of Entomology, Kansas State College.
[2] U.S.D.A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine.
[3] Kansas Agricultural Experiment Station, Manhattan, Kansas.
[4] Compound 118, a chlorinated hydrocarbon having the chemical name 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8,-dimethanonaphthalene with an empirical formula of $C_{12}H_8Cl_1$ and the trade name of Octalene.

rubrum together with many nymphs and adults of **M. bivittatus.**

The grasshopper population of each plot was determined immediately before treatment with the insecticides and again at the end of 24 and 72 hours after treatment by sweeping the vegetation with an insect net, 15 inches in diameter, at the proper height to catch the grasshoppers. Thirty collection units, each consisting of three sweeps of the net, were taken on each plot. The reduction in grasshopper populations at the end of the 24 and 72 hour observation periods was calculated from E. J. Hinman's adaptation of Abbot's formula (1), and can be stated as follows:

$$\text{Percent reduction} = 100\left(1 - \frac{TA \times CB}{TB \times CA}\right)$$

Where: TA is the total number of grasshoppers collected on the test plot after treating; CB is the total number of grasshoppers on the check plot before treating; TB is the total number of grasshoppers on the test plot before treating; and CA is the total number of grasshoppers on the check plot after treating.

The sprays used in these tests were applied with a John Bean Model 4-E two-wheeled sprayer, operating at 250 pounds pressure per square inch, using a Model 785 H Bean Spraymaster gun. The spray gun was directed carefully in order to secure an even distribution of the spray over the vegetation of the rod-wide roadside strips. With these operating conditions, 25 gallons of spray were used to cover each one-acre plot as the sprayer was

Table 1.—Average reduction in grasshopper population following insecticide applications, Finney County, Kansas, June 1948. (Five replicates).

Material	Insecticide per acre	Reduction in Population	
		24 hours after application	72 hours after application
	Pounds	Percent	Percent
Chlordane (1 pint of emulsifiable concencentrate, containing 8 pounds of chlordane per gallon, in 25 gallons of water).	1.0*	77	83
Toxaphene (1.5 pints of emulsifiable concentrate, containing 8 pounds of toxaphene per gallon, in 25 gallons of water).	1.5	58	83
Parathion (2.4 pounds of 25% wettable powder in 25 gallons of water).	0.6**	80	82
Sodium fluosilicate bait (20 pounds [wet weight] per acre of the following mixture: 100 pounds bran, 3 times that bulk of sawdust, 16 pounds sodium fluosilicate, about 45 gallons of water).	0.4	49	19

* One replicate received 2 lbs. of chlordane per acre.

** One replicate received 0.875 lbs. of parathion per acre.

pulled behind a car at the rate of three miles per hour. The bait was applied with a self-powered U.S.D.A. bait spreader for which the rate of delivery had been carefully predetermined. The insecticide formulations used on the plots that were treated in June and the grasshopper mortalities resulting therefrom are given in Table 1.

Western Kansas Tests, August 1948

The August tests in Finney County, like the June tests, consisted of a series of five replicates; each replicate was composed of five one-acre plots along weedy roadsides. The tests were conducted on August 25, 26, 27, 29 and 30. Because of the abundant rainfall received during the summer months, the plots used for this series of tests contained a rather succulent growth of Russian thistle, fire weed, sunflower, giant ragweed and smartweed although, as previously stated, some of this vegetation had ripened and started to dry.

In contrast to the several species of grasshoppers which were abundant during June, the grasshopper population in August was predominantly **M. mexicanus mexicanus** (Sauss.) of which an estimated 75 percent were nymphs of the second generation. The average population of the 25 plots was six grasshoppers per square yard. The population of each plot was determined before and after treatment in the same manner as for the June tests except that five sweeps of the insect net were used for one unit because of the smaller numbers of grasshoppers present. Reductions in populations were calculated by means of the formula already given. The insecticides used on this series of plots and the methods of application were the same as for the June tests except that the amounts of chlordane and toxaphene were in-

Table 2.—Average reduction in grasshopper population following insecticide applications, Finney County, Kansas, August 1948. (Five replicates).

Material	Actual insecticide per acre	Reduction in Population	
		24 hours after application	72 hours after application
	Pounds	Percent	Percent
Chlordane (1.5 pints of emulsifiable concentrate, containing 8 pounds of chlordane per gallon, in 25 gallons of water).	1.5	75	85
Toxaphene, (2.25 pints of emulsifiable concentrate, containing 8 pounds of toxaphene per gallon, in 25 gallons of water).	2.25	83	86
Parathion (2.4 pounds of 25% wettable powder in 25 gallons of water).	0.6	91	91
Sodium fluosilicate bait (20 pounds [wet weight] per acre of the following mixture: 100 pounds bran, 3 times that bulk of sawdust, 16 pounds sodium fluosilicate, about 45 gallons of water).	0.4	51	54

creased. The formulations applied and the average grasshopper mortalities resulting therefrom are given in Table 2.

Eastern Kansas Tests, September 1948

The Riley County tests were begun on September 27 and consisted of five adjacent, one-acre plots approximately 114 feet by 384 feet laid out in a field of spring-seeded sweet clover which was about 15 inches high and contained a short undergrowth of foxtail and other grasses. The grasshoppers were practically all adult **M. mexicanus mexicanus** (Sauss.) and averaged five per square yard very uniformly throughout the five plots.

The grasshopper population for each plot was determined immediately before treatment with the insecticides and again at the end of 24 hours, 72 hours and 7 days after treatment. The method used was the same as that employed for the June tests in Finney County except that four sweeps of the insect net constituted a unit and 25 such units were taken from each plot.

All of the insecticides were applied with the same Bean sprayer used in the Finney County tests, which was equipped in this instance with a 16-foot boom, bearing 13 nozzles spaced 14 inches apart. With the boom attachment, the sprayer applied 37 gallons of spray per acre when pulled behind a car at the rate of 3 miles per hour. The formulations used and the grasshopper mortalities resulting therefrom are given in Table 3.

Table 3.—Reductions in grasshopper populations following insecticide applications to single plots, Riley County, Kansas, September, 1948

Material	Actual insecticide per acre	Reduction in Population		
		24 hours after application	72 hours after application	7 days after application
	Pounds	Percent	Percent	Percent
Chlordane (1.5 pints of emulsifiable concentrate, containing 8 pounds of chlordane per gallon, in 37 gallons of water).	1.5	45	83	100
Toxaphene, (2.25 pints of emulsifiable concentrate, containing 8 pounds of toxaphene per gallon, in 37 gallons of water).	2.25	62	76	93
Parathion (2 pounds of 25% wettable powder in 37 gallons of water).	0.5	100	95	92
Compound 118 (1 pint of emulsifiable concentrate, containing 4 pounds of Compound 118 per gallon, in 37 gallons of water).	0.5	84	82	100

Summary

Comparsons of the grasshopper killing effectiveness of chlordane, toxaphene, parathion, Compound 118 sprays and sodium fluosilicate bait were made by applying these materials to one-acre plots of both roadside and field vegetation that were infested by several species of grasshoppers. Emulsifiable

concentrates of chlordane, toxaphene and Compound 118, and a wettable powder containing parathion were mixed with water and sprayed onto the foliage. The sodium fluosilicate bait, made according to standard wet-bait formula, was broadcast in the usual way. Two series of tests were made in Finney County in southwestern Kansas and a single test was made in Riley County in northeastern Kansas.

The insecticides were applied at the following rates: chlordane, 1 and 1.5 pounds per acre; toxaphene, 1.5 and 2.25 pounds per acre; parathion, 0.5 and 0.6 pounds per acre; Compound 118, 0.5 pounds per acre; and sodium fluosilicate, 0.4 pounds per acre. All of the new insecticides used in these tests, killed a higher percentage of the nymphal and adult stages of the grasshoppers present and remained effective longer than did the standard fluosilicate bait.

The average percentage reductions in grasshopper populations for all the tests at the end of 72 hours after applications were as follows: chlordane (11 replicates), 84; toxaphene (11 replicates), 84; parathion (11 replicates), 87; Compound 118 (single plot), 82; and sodium fluosilicate bait (10 replicates), 37. The new insecticides evidently remained effective for some time after application. In one test the grasshopper mortalities caused by all of the insecticides except parathion at the end of 7 days after application were materially higher than those prevailing at the end of 72 hours, as shown by the following percentages: chlordane, 100; toxaphene, 93; parathion, 92; and Compound 118, 100.

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NEW GENERA AND SUBGENERA OF SATURNIIDAE (LEPIDOPTERA): A CORRECTION

CHARLES D. MICHENER
University of Kansas, Lawrence

In the last number of this journal an unfortunate printer's error should be corrected as follows: From last line, p. 144, go to first line, p. 146. From line 11, p. 146, go to first line, p. 145. From last line, p. 145, go to line 12, p. 146.

This error leaves the description of **Ptiloscola**, a subgenus of **Adelowalkeria**, so separated from the name that it cannot be considered as validly proposed. The diagnosis is therefore printed as follows:

Ptiloscola new subgenus

Type species: **Adelocephala lilacina** Schaus.

This is a distinctive-looking group of gray or brown species, usually with the abdomen banded. There is no free anellus in the male, a character which separates this subgenus from **Scolesa**. Each harpe has a basal ventral process, that of the right harpe much larger than that of the left.

THE PHYLLOPHAGA OF TEXAS (SCARABAEIDAE, COLEOPTERA)[1]

H. J. REINHARD
College Station, Texas

The genus **Phyllophaga,** sens. lat., as herein considered, is represented in Texas by nearly 100 described species. The adults of this large group of insects are commonly known as "May-beetles" or "June-bugs" and the larvae as "White-grubs" or "Grubworms." From the standpoint of economic importance the depredations caused by the feeding activities of both adults and larvae are generally well known. The adults, with a few exceptions, are nocturnal in habit and frequently defoliate trees and shrubs and likewise feed upon the foliage of certain kinds of truck crops. They lay their eggs in the soil during the daytime. The larvae remain in the soil and feed upon the roots, tubers and bulbs of a wide variety of growing plants. Those belonging to the grass family are especially subject to attack and are destroyed over extensive areas.

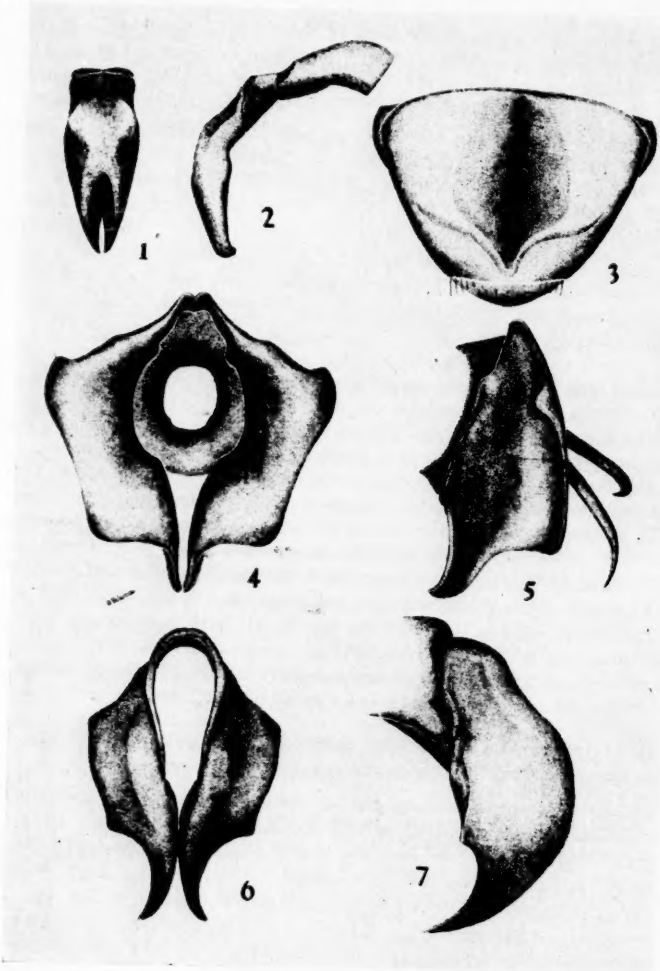
This paper presents a brief summary of the data which have been accumulated during the past 10 to 12 years on this important group of insects. Most of the material here recorded is contained in the Texas A. & M. College Collection. Credit is due to many workers for the collection of material, which has materially increased the number of species here included. Drs. S. E. Jones, M. J. Janes, W. H. Ewart and Messrs. W. L. Owen, Jr., E. T. Hibbs, S. W. Clark, Hal Parks, L. J. Bottimer, and Ted McGregor all have contributed material, which to conserve space, is not specifically accredited in all cases in the following list. To all these workers and others, who from time to time contributed to the progress of this study I extend my sincere appreciation. Also, I am especially indebted to Dr. M. W. Sanderson for the loan of material and for many other kindnesses.

(62) **Phyllophaga riviera** Reinhard, n. sp.

(Figures 1 and 2)

Male.—Form elongate, subparallel, feebly shining and apparently glabrous above, pale yellowish testaceous, head and thorax rufous. Clypeus entire, moderately reflexed, sparsely, finely punctate; front convex, more coarsely and deeply punctate than clypeus. Antenna 10-segmented, club bowed apically, paler in color and slightly exceeding length of stem. Thorax with lateral margins entire and roundedly dilated, hind angles obtuse but distinct, disk finely, sparsely and somewhat irregularly punctate. Metasternum closely, finely punctate and moderately clothed with longish yellow hairs. Fore tibia tridentate, tarsus without projections at inner apex of each segment. Tarsal claws with a smallish triangular tooth before middle. Spurs of hind tibia free, outer rather slender and fully three-fourths length

[1] Contribution No. 1204, Department of Entomology, Texas Agricultural Experiment Station.



EXPLANATION OF PLATE

(Genital structures of new species of **Phyllophaga**)

Figures 1-2. **Phyllophaga riviera,** n. sp. (1) Rear view of male claspers; (2) Lateral view of male aedeagus.

Figures 3-5. **Phyllophaga (Listrochelus) bottimeri,** n. sp. (3) Pygidium of female; (4) Rear view of male claspers; (5) Lateral view of male claspers.

Figures 6-7. **Phyllophaga (Listrochelus) planeta,** n. sp. (6) Rear view of male claspers; (7) Lateral view of male claspers.

of inner one. Elytra finely, sparsely sculptured, the punctures shallow and somewhat irregular, many near base bearing short decumbent hairs; costae, except sutural, poorly defined. Abdomen feebly shining, flattened at middle, very sparsely and finely punctate at sides, fifth segment simple, about twice longer than sixth. Pygidium convex, apparently glabrous, feebly shining, very sparsely and finely punctate, apical margin rounded, slightly reflexed. Genitalia symmetrical and similar in structure to **ignava**, but the aedeagal opening is larger, much more elongate and the claspers are divided apically on ventral side by a moderately deep V-shaped incision.

Length.—13-15 mm.; width, 5-6 mm.

Holotype male, Riviera, Texas, May 10, 1946, in the Texas A. & M. College Collection. Paratypes: 136 males, same data as type, April to June, 1946-47, all collected by personnel of the Texas State Health Department.

This new species was discovered among some light trap material submitted for study by the Texas State Health Department. Although apparently common in Kleberg County during May and June, 1946, no female specimens were encountered in the available material. In build and genitalic characters the species resemble **P. ignava**, but differs widely in coloration and in several morphological details. Among the latter perhaps the most obvious are the finer and sparser puncturation of the upper body surface, the non-emarginate clypeus, the entire lateral thoracic margins and the flattened venter of the abdomen in the male. Nothing is known concerning the biology of the species, however, the late seasonal peak of adult activity seemingly indicates that pupation occurs in the spring.

(77) **Phyllophaga (Listrochelus) bottimeri** Reinhard, n. sp.
(Figures 3, 4 and 5)

Male.—Form robust, moderately elongate, rufocastaneous, pruinose, head and thorax above wholly shining. Head with a strong transverse carina, behind it the surface at sides finely, sparsely punctate; clypeus entire, narrowly reflexed, rather finely and closely punctate; front with slightly coarser and sparser punctures than on clypeus. Antenna 10-segmented, rufotestaceous, club about as long as funicle. Thorax finely not closely punctate, smoother on median line of disk, base and apex strongly margined, sides at middle roundedly dilated, with lateral margin finely crenulate and ciliate, front and hind angles obtuse but distinctly angulate. Metasternum finely, closely punctate, clothed with long pale tawny hairs. All tarsal claws strongly pectinate along a double margin and none with a larger intercalated tooth; hind tarsus slender, longer than tibia, two basal segments subequal in length; hind tibial spurs free, long and slender, outer subacute and slightly shorter than blunt-tipped inner one. Elytra pruinose, finely not closely punctate, with sparse, short, suberect hairs; costae except sutural rather feebly defined. Abdomen pruinose, finely, setiferously punctate, venter flattened; fifth segment simple; sixth distinctly shorter, shiny, coarsely punctate and rather deeply furrowed on median line. Pygidium convex but with disk somewhat flattened, basal two-thirds pruinose and finely punctate with short, erect, brownish hairs, apical surface shiny, more coarsely punctate and bearing somewhat longer concolorous hairs.

Female.—Head and thorax a little more coarsely and deeply punctate. Antennal club about two-thirds length of funicle. Pygidium largely pruinose, with a sparse vestiture of short, erect hairs; disk broadly concave to middle, behind which the surface is distinctly raised in the form of two oblique or V-shaped ridges, thence flattened to apex, latter shining, sparsely and more coarsely punctate. Abdomen with sparse, fine, setiferous punctures, pruinose, venter convex and moderately shining; sixth segment shorter than fifth but more densely, coarsely punctate and with longer, denser hairs. All tarsal claws serrate or subpectinate along a double margin and each bearing a moderately large triangular median tooth. Otherwise similar to male.

Length.—18-20 mm.; width, 7.5-8 mm.

Holotype male and allotype female, Big Bend National Park, Texas, June 10, 1948 (L. J. Bottimer) in the U. S. National Museum. Paratypes: Two males and one female, same data as type; and 1 male from the same locality taken by H. S. Barber.

In Saylor's key (Proc. U. S. N. M., 89) the species traces to **P. huachuca**, to which it appears most closely allied. The male genitalic and female pygidial characters readily distinguish the present species, which is named for L. J. Bottimer, who collected most of the type series.

(86) **Phyllophaga (Listrochelus) planeta** Reinhard, n. sp.

(Figures 6 and 7)

Male.—Form oblong ovate, slightly wider behind; shining, glabrous above, head and thorax rufous, elytra rufotestaceous. Head without a well defined transverse carina at vertex; front rather sparsely, coarsely punctate, flattened at middle anteriorly and less distinctly so at sides; clypeus feebly emarginate, moderately reflexed, more closely punctate than front. Antenna 10-segmented, club subequal length of funicle, latter with second segment a trifle longer than third. Thorax arcuately dilated at sides, with margin crenate and ciliate, hind angles broadly rounded, the front ones obtuse but distinct; disk finely, not closely punctate, smoother on narrow median line and at sides on basal margin. Metasternum pruinose, very finely and closely punctate, with dense moderately long whitish hairs. Legs rufotestaceous; first three segments of front tarsus with a small inner spine at apex, basal segment of hind tarsus slightly shorter than second. Front tibia tridentate, but the upper tooth small; spurs of hind tibia free, slender, outer slightly bowed, subacute and about three-fourths as long as inner one. Tarsal claws pectinate along a single margin, without larger intercalated teeth. Elytra punctured as thorax but more regularly so; sutural costae and humeri prominent, lateral margin ciliate on basal half. Abdomen faintly pruinose at sides, with sparse, fine, setiferous punctures, venter flattened and shining; apical half of fifth and all of sixth segment with a fine longitudinal impression on median line; sixth segment very short, with a fringe of short hairs on hind margin. Pygidium gibbous near base, wholly shiny and glabrous, finely, sparsely and irregularly punctate, apex rounded, margin slightly reflexed.

Female.—Antennal club much shorter than funicle. Sixth abdominal segment at least half as long as fifth, broadly emarginate at middle of

hind margin and coarsely punctate on median area; venter barely flattened at middle, mostly shining with a sublateral pollinose spot on fifth segment, which bears a sparse vestiture of longish pale hairs. Pygidium shining and punctured as in male but the disk in profile is evenly convex from base to apex; latter truncate and unmargined. Tarsal claws serrate along a single margin, with an acute larger tooth slightly beyond middle.

Length.—12 mm.; width 6 mm.

Holotype male and allotype female, Ft. Davis, Texas, June 11, 1948, taken at light by L. J. Bottimer; deposited in the U. S. National Museum.

This small species is perhaps most closely allied to **meadei** Saylor, from which it differs chiefly in the male gentalia and female pygidium. The latter in **meadei** is described as being widely and transversely gibbose before the apex.

In the accompanying key, based upon males only, the diagnostic characters employed are in large measure similar to those used in previously published works. Although the females in general possess a smaller variety of external morphological characters, they are nevertheless specifically distinguishable in most cases by the genitalic structure and other items. A separate key to the species for this sex is omitted to save space. With a few exceptions the proper association of sexes is not unusually difficult. As a rule the female of a given species differs from its corresponding male mainly in secondary sexual characters. Females not associated with the opposite sex at the time of collection in most cases may be readily matched by the similarity of habitus with the male.

KEY TO THE MALES OF GENUS PHYLLOPHAGA

1. Claws of tarsi narrowly cleft ..... 2.
   Claws of tarsi toothed, pectinate or serrate, never cleft ..... 5.
2. (1) Tarsal segments at most very sparsely pilose beneath; metasternum finely closely punctate, with a vestiture of dense long hairs ..... 3.
   Tarsal segments at least moderately pilose beneath; metasternum rather coarsely sparsely punctate, the hairs very sparse and short ..... **vexata** (Horn).
3. (2) Inner spur of hind tibia free; elytra glabrous ..... 4.
   Inner spur of hind tibia fixed; elytra clothed with sparse short suberect hairs; fifth ventral abdominal segment simple ..... **trichodes** (Bates).
4. (3) Antenna 10-segmented, club large usually exceeding length of stem; fifth ventral abdominal segment with a distinct carina near hind margin; pygidium convex, with sparse suberect hairs; lower tooth of claw acute, longer than upper one ..... **obsoleta vanalleri** (Schaeffer).
   Antenna 9-segmented; fifth abdominal segment simple; pygidium glabrous, slightly tumid at middle, basal half with a fine longitudinal impressed line; lower tooth of claw subtruncate, shorter than upper one ..... **nosa** Blackwelder.
5. (1) Claws finely or coarsely serrate to pectinate with or without a larger intercalated triangular tooth; vertex usually with a

well defined transverse carina ..... 6.
Claws with a small to strong tooth at or near middle, never serrate or pectinate; vertex not transversely carinate ..... 21.
6. (5) Claws distinctly pectinate ..... 7.
Claws faintly to strongly serrate ..... 12.
7. (6) Outer front claws without a large intercalated tooth before apex ..... 8.
Outer front claw with a large and distinct subapical tooth ..... 10.
8. (7) Elytra pruinose, with a vestiture of sparse short hairs; tarsal claws pectinate along two margins ..... 9.
Elytra glabrous and shining; tarsal claws pectinate along one margin; vertex without a well defined carina; small species (12 mm.); rufotestaceous ..... **planeta** Reinhard, n. sp.
9. (8) Head coarsely and very densely punctate, carina of vertex moderately defined; pygidium strongly convex, with fine sparse punctures; basal piece of genitalia (tectum) with several to many moderately long coarse bristles on lower margin of apical extremity ..... **chapini** Saylor.
Head finely, not densely punctate, vertex with a strong transverse carina; pygidium distinctly flattened on disk, the apex much more coarsely punctate than basal half; basal piece of genitalia not bristled on lower apical extremity ..... **bottimeri** Reinhard, n. sp.
10. (7) Claspers in lateral view with apical margin not reflexed much below middle ..... 11.
Claspers in lateral view with entire apical margin narrowly and evenly reflexed; in distal view the claspers terminate in well separated narrow prongs, which are grooved behind, with the tips bowed inward ..... **mucorea** (Leconte).
11. (10) Apical margin of claspers in lateral view reflexed near middle into a short lobe, remainder of margin not reflexed; in distal view the claspers taper apically, with the prongs separated but rather closely approximated on the straight inner margins, nearly flat behind and not bowed inward at the tips. ..... **pulcher** (Linell).
Apical margin of claspers reflexed from the posterior dorsal extremity downward to well below the middle; in distal view the claspers terminate in slender, widely separated prongs, which are distinctly bowed inward distally but the tips not closely approximated ..... **reinhardi** Saylor.
12. (6) Tarsal claws serrate along two margins ..... 13.
Tarsal claws serrate along one margin (at times indistinctly so) ..... 14.
13. (12) Antenna 9-segmented; pronotum and base of elytra with long fine hairs; all claws with a distinct tooth slightly beyond middle; form ovate slightly wider behind; pale yellow, head and pronotum rufous ..... **macmurryi** Saylor.
Antenna 10-segmented; pronotum and elytra apparently glabrous; all claws without or rarely the outer front claw with a distinct tooth beyond middle; form elongate subparallel; rufo-

testaceous ..... **wickhami** Saylor.

14. (12) Hind tarsus and tibia with long and usually rather dense fine hairs on inner side ..... 15.

Hind tarsus and tibia with shorter, sparser, coarse to bristly hairs on inner side ..... 16.

15. (14) First segment of front tarsus with a long spine-like projection at apex on inner side; hind tarsus with first segment strongly expanded distally and about two and one-half times as long as wide at apex ..... **koehleriana** Saylor.

First segment of front tarsus with a small inner spine; hind tarsus with first segment not strongly expanded apically and at least three times as long as wide at apex ..... **fimbripes** (Leconte).

16. (14) Abdomen obviously flattened at middle; hind tibia with moderately coarse sparse hairs on inner side ..... 17.

Abdomen transversely convex; hind tibia with a vestiture of bristly to spine-like hairs on inner side; pronotum and pygidium strongly shining ..... **parilis** (Bates).

17. (16) All claws with a moderately strong submedian tooth ..... 18.

All claws without a larger intercalated tooth (except outer front claw in **texensis**) ..... 19.

18. (17) Antennal club nearly one-third longer than funicle; pronotum rather sparsely punctate with a large median impunctate area; claspers in profile slightly produced near middle of apical dorsal and ventral margins ..... **arizona** Saylor.

Antennal club subequal to length of funicle; pronotum more closely punctate without any large impunctate area on disk; claspers in profile strongly produced on ventral margin and terminating in a pair of slightly bowed prongs ..... **cushmani** Saylor.

19. (17) All claws without a larger intercalated tooth ..... 20.

Outer front claw with a larger submedian tooth, inner claw without such tooth; pronotum closely punctate, shiny on disk with broad lateral margins and the elytra pruinose .... **texensis** Saylor.

20. (19) Antennal club very robust, exceeding length of funicle; pronotum sparsely coarsely punctured on disk; sixth ventral abdominal segment with a short truncate median lobe .... **senex** (Horn).

Antennal club not unusually large, subequal to length of funicle; pronotum densely finely and regularly punctured on disk; sixth abdominal segment simple ..... **scuticeps** (Bates).

21. (5) Hind tibia with both spurs free ..... 22.

Hind tibia with one spur fixed ..... 58.

22. (21) Apterous species; form robust ovate and strongly convex; humeri depressed ..... 23.

Alate species; form variable but never strongly convex, oblong ovate or subparallel to cylindrical; humeri distinctly convex ..... 25.

23. (22) Elytra costate, striae with fine punctures irregularly placed in more or less definite rows; pronotum coarsely densely punctate 24.

Elytra not costate, punctures fine, sparse and rather uniformly spaced; pronotal punctures but slightly coarser and denser than elytral; scutellum impunctate ..... **renodis** Reinhard.

24. (23) Scutellum always coarsely and usually densely punctate; apical inner margin of united claspers distinctly bidentate; disk of pronotum convex ..... **cribrosa** (Leconte).
Scutellum impunctate or at most with very minute scattered punctures; apical inner margin of claspers evenly rounded or ring-like in distal view; pronotum obviously flattened and declivent on anterior half of disk ..... **zavalana** Reinhard.
25. (22) Body above with a vestiture of hairs or scales ..... 26.
Body above glabrous or at most pruinose ..... .41
26. (25) Clypeus entire or at most feebly sinuate ..... 27.
Clypeus distinctly emarginate ..... 34.
27. (26) Dorsal vestiture at least in part scale-like ..... 28.
Dorsal vestiture composed entirely of hairs ..... 29.
28. (27) Head, pronotum and elytra with a dense vestiture of closely appressed scales; venter tuberculate on median line of intermediate segments ..... **lanceolata** (Say).
Head and pronotum clothed with long erect or procumbent hairs and the elytra with elongate appressed scales; venter simple .... **squamipilosa** Saylor.
Head glabrous; pronotum with a sparse vestiture of scale-like hairs, which are usually appressed but sometimes suberect at sides; elytra apparently glabrous but each puncture bearing a small scale-like seta; venter simple ..... **aequalis** (Leconte).
29. (27) Elytra with little or no pubescence ..... 30.
Elytra distinctly hairy ..... 31.
30. (29) Ventral abdominal carina absent; apical process of internal genital sac blunt-tipped, not protruding; form compact and moderately robust; rufotestaceous ..... **crinita** (Burmeister).
Ventral carina present but usually narrow and feebly elevated; apical process of internal genital sac elongate with curved narrow tip protruding; form moderately slender and elongate, yellowish testaceous ..... **antennata** (Smith).
31. (29) Apical process of internal genital sac tapering distally to an acute tip ..... 32.
Apical process of internal genital sac blunt-tipped ..... 33.
32. (31) Pronotum closely to densely punctate; apical process of internal genital sac subulate and rather short; ventral carina acutely elevated ..... **tristis tristis** (Fabricius).
Pronotum not closely punctate; apical process of internal genital sac flattened and thin in profile; ventral carina feebly elevated, obtuse on crest ..... **tristis suttonana** Reinhard.
33. (31) Ventral abdominal carina prominent, thin or blade-like; apical process of internal genital sac flattened on distal part, latter lanceolate to spatulate in outline as viewed from behind; antennal club bowed apically, longer than stem .... **tristis amplicornis** Reinhard.
Ventral carina feebly elevated, obtuse on crest; apical process of internal genital sac rather short and thick, tapered distally in profile to a slightly emarginate apex, with upper apical ex-

tremity produced as a short acute tooth; antennal club straight and shorter than stem ..... **tristis apicata** Reinhard.

34. (26) Pubescence of upper surface recumbent without any intermixed erect hairs ..... 35.

Pubescence of upper surface intermixed or erect ..... 37.

35. (34) Form subcylindrical; sculpturation very fine and dense ..... 36.

Form robust ovate; clypeus and front rather coarsely and densely punctate; antennal club scarcely as long as funicle .... **aemula** (Horn).

36. (35) Antennal club subequal to length of stem; fused claspers prolonged on ventral margin, which tapers distally to a narrow apex ..... **opacita** Reinhard.

Antennal club shorter than stem; claspers prolonged on ventral margin, which terminates in a broadly rounded apex ..... **arcta** (Horn).

37. (34) Margin of pronotum at most feebly serrate behind the middle (except **vetula**) ..... 38.

Margin of pronotum strongly crenate; antennal club about as long as funicle ..... **crenulata** (Froehlich).

38. (37) Antennal club subequal to length of stem ..... 39.

Antennal club much shorter than stem; front coarsely rugosely punctured, pronotal margin coarsely serrate; elytra with some very long coarse erect brownish hairs on inner basal margin ..... **vetula** (Horn).

39. (38) Pronotum shiny, punctures fine not dense; claspers fused on ventral side ..... 40.

Pronotum subopaque, punctures very fine and close to dense; claspers not fused on ventral side, terminating in rather slender converging prongs; tooth of tarsal claws rather small intramedian; pygidium finely closely punctate ..... **parvidens** (Leconte).

40. (39) First segment of hind tarsus distinctly shorter than second; surface of elytra opaque or pruinose; tooth of tarsal claws large, median; pygidium rather coarsely not closely punctate ..... **rubiginosa** (Leconte).

First segment of hind tibia slightly longer than second; surface of elytra shiny; tooth of tarsal claws before middle, acute, short and triangular ..... **elizoria** Saylor.

41. (25) Claspers fused, the inner apical margin ring-shaped ..... 42.

Claspers divided ventrally and terminating in a pair of beak-like contiguous, divergent or widely separated prongs ..... 46.

42. (41) Claws of middle tarsus dissimilar ..... 43.

Claws of middle tarsus similar ..... 44.

43. (42) Antennal club nearly one-half longer than stem; pygidium smooth at most indistinctly sparsely punctate .... **heterodoxa** (Horn).

Antennal club shorter than stem; pygidium minutely but distinctly punctate ..... **ravida guatemalica** Moser.

44. (42) Small feebly shining species (9-15 mm. in length); abdomen finely punctate 45

Larger shining species (17-19 mm. in length); metasternum sparsely punctate and very thinly short-haired; abdomen almost impunctate except remotely near the sides; tooth of claws

small, near base ..... **pusillidens** Fall.

45. (44) Black including legs and antenna, club of latter at times with a reddish tinge; scutellum impunctate or nearly so; tooth of claws small to obsolete ..... **epigaea** (Wickham).

Reddish brown including legs and antenna, club of latter pale reddish to yellow; scutellum punctate at least on apical part; tooth of claws always well developed, acute ..... **rubricosa** Reinhard.

46. (41) Spurs of hind tibia broad, flat and blade-like ..... 47.

Spurs of hind tibia slender, inner one at times contorted or very short ..... 48.

47. (46) Antennal club equal the length of stem; inner spur of hind tibia lanceolate, three-fourths the length of outer; metasternum closely punctate, the hairs long and dense ..... **pleroma** Reinhard.

Antennal club shorter than stem; inner spur of hind tibia broad, obliquely truncate at apex and much shorter than outer; metasternum not closely punctate, the hairs short and sparse ..... **farcta** (Leconte).

48. (46) Inner spur of hind tibia tortate or strongly bowed ..... 49.

Inner spur of hind tibia simple ..... 50.

49. (48) Large robust species, form depressed; inner spur of hind tibia inserted on inner side of apex of tibia and sharply bowed inward at middle; fifth ventral segment of abdomen simple..... **torta** (Leconte).

Smaller species, not robust, form subcylindrical; inner spur of hind tibia arcuate, inserted in apex of tibia; fifth ventral segment of abdomen declivent at middle of posterior half....**hamata** (Horn).

50. (48) Antenna 10-segmented ..... 51.

Antenna 9-segmented ..... 56.

51. (50) Form moderately robust; venter flattened at middle ..... 52.

Form elongate parallel; venter transversely convex (except **riviera**).. 53.

52. (51) Pronotum and elytra irridescent; fifth ventral segment of abdomen abruptly thickened on hind margin and roughened with acute granulations ..... **submucida** (Leconte).

Pronotum and elytra shiny and without any irridescent sheen; fifth ventral segment of abdomen obliquely declivent and finely granulate on posterior half ..... **glabricula** (Leconte).

53. (51) Clypeus emarginate ..... 54.

Clypeus entire; elytra pale yellow testaceous; pronotum rufous, lateral margin entire; antennal club pale yellow, bowed, as long as stem ..... **riviera** Reinhard, n. sp.

54. (53) Margin of pronotum crenate; claspers divided apically but contiguous at apex; antennal club subequal to length of stem..... 55.

Margin of pronotum entire; claspers divergent apically; antennal club shorter than stem ..... **psiloptera** Sanderson.

55. (54) Head densely and rather coarsely punctate; claspers with a smallish circular aedeagal opening on hind side before apex; tooth of tarsal claws slightly before middle..... **ignava** (Horn).

Head not densely punctate, the punctures distinctly finer on clypeus than on front; aedeagal opening of claspers extending

from near basal third to apex and strongly constricted below the middle; tooth of claws median ..... **idonea** Sanderson.

56 (50) Front tibia tridentate; fifth ventral segment of abdomen simple ..... 57.

Front tibia bidentate; inner spur of hind tibia nearly as long as the outer; clypeus entire; fifth ventral abdominal segment near hind margin with a transverse carina bearing a small dentiform process at middle ..... **tusa** (Horn).

57. (56) Inner spur of hind tibia very short; clypeus emarginate; venter broadly flattened at middle; tooth of tarsal claws subbasal ..... (part) **affabilis** (Horn).

Inner spur of hind tibia long and slender; clypeus subtruncate; venter transversely convex; tooth of tarsal claws slightly before middle ..... **gaigei** Sanderson.

58. (21) Antenna 9-segmented ..... 59.

Antenna 10-segmented ..... 62.

59. (58) Hind tibia obliquely truncate at apex ..... 60.

Hind tibia emarginate near base of inner spur; clypeus entire or nearly so; form elongate parallel, rufotestaceous ..... **taxodii** Langston.

60. (59) Clypeus distinctly emarginate ..... 61.

Clypeus entire; form oblong slightly wider behind; rufotestaceous, head darker ..... **clemens** (Horn).

61. (60) Abdomen slightly flattened at middle, sixth segment distinctly longer than fifth on median line; form elongate cylindrical; pale yellow, head fuscous ..... **longitarsa** (Say).

Abdomen broadly flattened at middle, sixth segment shorter than fifth; form oblong, subcylindrical; elytra light brownish pronotum and head rufous ..... (part) **affabilis** (Horn).

62. (58) Claspers symmetrical ..... 63.

Claspers asymmetrical ..... 75.

63. (62) Hind tibia obliquely to squarely truncate at apex ..... 64.

Hind tibia emarginate at apex near base of inner spur ..... 71.

64. (63) Elytra at least moderately shining ..... 65.

Elytra pruinose or irridescent ..... 67.

65. (64) Inner spur of hind tibia very short; form moderately elongate cyclindrical ..... 66.

Inner spur of hind tibia about one-half as long as outer; form ovate, robust; elytra moderately shining, rufocastaneous ..... (part) **crassissima** (Blanchard).

66. (65) Sixth ventral abdominal segment abruptly depressed and roughened at middle, the apex emarginate with an obtuse cusp on each side of emargination; aedeagal opening of claspers elongate ovate ..... **ephilida** (Say).

Sixth abdominal segment as described above but the aedeagal opening of claspers circular or nearly so ..... **ephilida virilis** Reinhard.

67. (64) Venter flattened at middle; antennal club distinctly longer than funicle ..... 68.

Venter transversely convex; antennal club obviously shorter than funicle; form robust widened behind; submedian tooth

of claws as long as apical one ..... **temora** Saylor.

68. (67) Form elongate subparallel; elytra pruinose ..... 69.
Form ovate, robust; elytra irridescent to feebly pruinose; fifth ventral abdominal segment with a roughened feeble transverse carina near the hind margin, last segment deeply concave and smooth at middle ..... (part) **crassissima** (Blanchard).

69. (68) Ventral abdominal segment strongly arcuate, extending from base of fifth segment to near hind margin of same; sixth segment moderately to deeply impressed ..... 70.
Ventral carina largely behind the middle of fifth abdominal segment and only slightly arcuate; sixth segment flattened or at most vaguely impressed at the middle ..... **sacoma** Reinhard.

70. (69) Sixth ventral abdominal segment with a moderately deep broad impression at the middle; claspers with a pair of dorsally directed slender falciform processes ..... **micans** (Knoch).
Sixth abdominal segment with a deep cup-shaped impression at the middle; claspers with a pair of short triangular dorsally directed processes ..... **micans cupuliformis** Langston.

71. (63) Form slender, subcylindrical; yellowish testaceous; tooth of claws small ..... 72.
Form oblong ovate, subrobust; reddish brown to rufotestaceous; tooth of claws strong ..... 73.

72. (71) Claspers uniformly arcuate on apical lateral margin, ventral process with a small tooth on inner margin near base ..... **gracilis** (Burmeister).
Claspers angularly produced on apical lateral margin, ventral process obtusely toothed on inner margin near middle ..... **gracilis angulata** Glasgow.

73. (71) Inner spur of hind tibia simple at most slightly bowed or hooked at tip ..... 74.
Inner spur of hind tibia arcuate from base to middle thence with a sharp reverse angle, the apical part straight and flattened on the hind side ..... **futilis** (Leconte).

74. (73) Venter conspicuously haired; tooth of claws large, slightly before middle ..... **hirtiventris** (Horn).
Venter glabrous; tooth of claws moderately large, median ..... **congrua** (Leconte).

75. (62) Hind tibia obliquely to squarely truncate at the apex ..... 76.
Hind tibia moderately to deeply emarginate near base of inner spur 93.

76. (75) Elytra glabrous ..... 77.
Elytra sparsely to moderately haired ..... 91.

77. (76) First segment of hind tarsus simple ..... 78.
First segment of hind tarsus with an abruptly formed process on outer side near the apex ..... **calceata** (Leconte).

78. (77) Inner spur of hind tibia very short ..... 79.
Inner spur of hind tibia at least one-half as long as the outer ..... 80.

79. (78) Margin of pronotum entire; form elongate; rufotestaceous; ventral carina slightly roughened and near hind margin of the fifth abdominal segment ..... **praetermissa** (Horn).

Margin of thorax serrate; form ovate; castaneous; ventral carina roughened, strongly arcuate and near middle of the fifth abdominal segment ..... **arkansana** (Schaeffer).

80. (78) Clypeus not densely punctate, feebly emarginate ..... 81.
Clypeus densely punctate, moderately deeply emarginate ..... 86.

81. (80) Ventral abdominal carina strongly elevated and more or less excavated behind ..... 82.
Ventral carina feebly elevated, fifth segment behind latter with a roughened semicircular depression; hind margin of sixth segment slightly bisinuous; inner spur of hind tibia rather broad, obtuse, one-half as long as outer ..... **inversa** (Horn).

82. (81) Ventral abdominal carina not or incompletely interrupted at middle ..... 83.
Ventral carina deeply divided at middle; hind margin of the fifth segment strongly emarginate; inner spur of hind tibia slightly curved, subacute and two-thirds as long as outer..... **bipartita** (Horn).

83. (82) Hind femur normal in form; inner spur of hind tibia simple or gently bowed from base to tip ..... 84.
Hind femur broadly angulate before middle on the posterior margin; inner spur of hind tibia arcuate and slightly hooked at the tip ..... **vehemens** (Horn).

84. (83) Ventral abdominal carina strongly arcuate, situated at or near middle of the fifth segment ..... 85.
Ventral carina nearly transverse at hind margin of the fifth segment; form broad oblong; inner spur of hind tibia gently curved, subacute and fully two-thirds the length of outer ..... **karlsioei** (Linell).

85. (84) Ventral abdominal carina deeply excavated behind and over-hanging hind margin of the fifth segment at sides ..... **fervida** (Fabricius).
Ventral carina feebly excavated behind but not reaching to the hind margin of fifth segment at the sides ..... **anxia** (Leconte).

86. (80) Antennal club not exceeding the length of funicle ..... 87.
Antennal club distinctly longer than funicle ..... 89.

87. (86) Claspers strongly asymmetrical ..... 88.
Claspers nearly symmetrical, the apical posterior angle on each side acutely produced and bowed inward; lateral margin of pronotum indistinctly crenate; elytra strongly rugose, the punctures obliterated except near the base and sides; inner spur of hind tibia one-half as long as the outer .... **incuria** Sanderson.

88. (87) Form elongate subparallel; deep brown to blackish; left clasper large and in lateral view entirely concealing the right one, broadly rounded on the apical edge; lateral margin of pronotum entire or nearly so behind the middle ..... **fraterna** Harris.
Form oblong ovate, slightly wider behind; elytra reddish brown, pronotum and head darker; left clasper not larger than the right, the apical margin bearing a prominent incurved lobe near the middle; lateral margin of pronotum crenate ..... **forsteri** (Burmeister).

89. (86) Pronotum irregularly punctured; left clasper without an acute ridge on outer side ..... 90.
Pronotum densely and regularly punctate with a smooth feebly elevated median line; left clasper with a sharp-crested oblique ridge near middle on outer side and deeply concave immediately behind the latter; large robust in build .... **profunda** (Blanchard).
90. (89) Pygidium with fine and rather sparse, feebly impressed punctures; left clasper evenly concave on inner side; elytra slightly rugulose at sides; uniformly dark brown .... **curialis** Reinhard.
Pygidium with coarser, well impressed punctures; left clasper with a strong transverse ridge slightly behind middle on inner side; elytra rugose; deep reddish to brown ..... **rugosa** (Melsheimer).
91. (76) Elytra with a sparse vestiture of intermixed short and longer erect hairs, surface moderately shining ..... 92.
Elytra with a denser vestiture of uniformly short recumbent fine hairs, surface subopaque; pronotum shiny, rather coarsely not closely punctate; antennal club equal to or slightly exceeding the length of funicle ..... **delata** (Horn).
92. (91) Pronotum coarsely closely punctate, with a vestiture of erect pale brownish hairs; head similarly haired; left clasper large and evenly rounded on the apical margin ..... **hirticula** (Knoch).
Pronotum rather finely not closely punctate, apparently glabrous but with scattered minute appressed whitish hairs, which are somewhat longer at the sides; head glabrous; apical margin of left clasper with an acute-tipped incurved process near middle ..... **pudorosa** Reinhard.
93. (75) Apex of hind tibia very deeply excavated near base of inner spur ..... 94.
Apex of hind tibia at most moderately emarginate near base of inner spur ..... 95.
94. (93) Elytra pruinose, deep reddish brown, head and pronotum darker, shining ..... **prunina** (Leconte).
Elytra wholly shining, uniformly dark brown, head and pronotum concolorous ..... **sodalis** Reinhard.
95. (93) Pronotal punctures well separated and never confluent at middle of disk ..... 96.
Pronotal punctures dense and transversely confluent on disk; antennal club obviously longer than funicle; elytra shining, light yellowish brown, head and pronotum opaque, darker .... **scitula** (Horn).
96. (95) Clypeus densely punctate; pronotal punctures at sides moderately coarse and close; united base of claspers strongly narrowed and produced at middle of the dorsal margin as viewed from behind ..... **sylvatica** Sanderson.
Clypeus not densely punctate; pronotal punctures at sides coarser and usually well separated; united base of claspers narrowed but not strongly produced at middle of the dorsal margin ..... **corrosa** (Leconte).

(to be concluded in April issue).

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